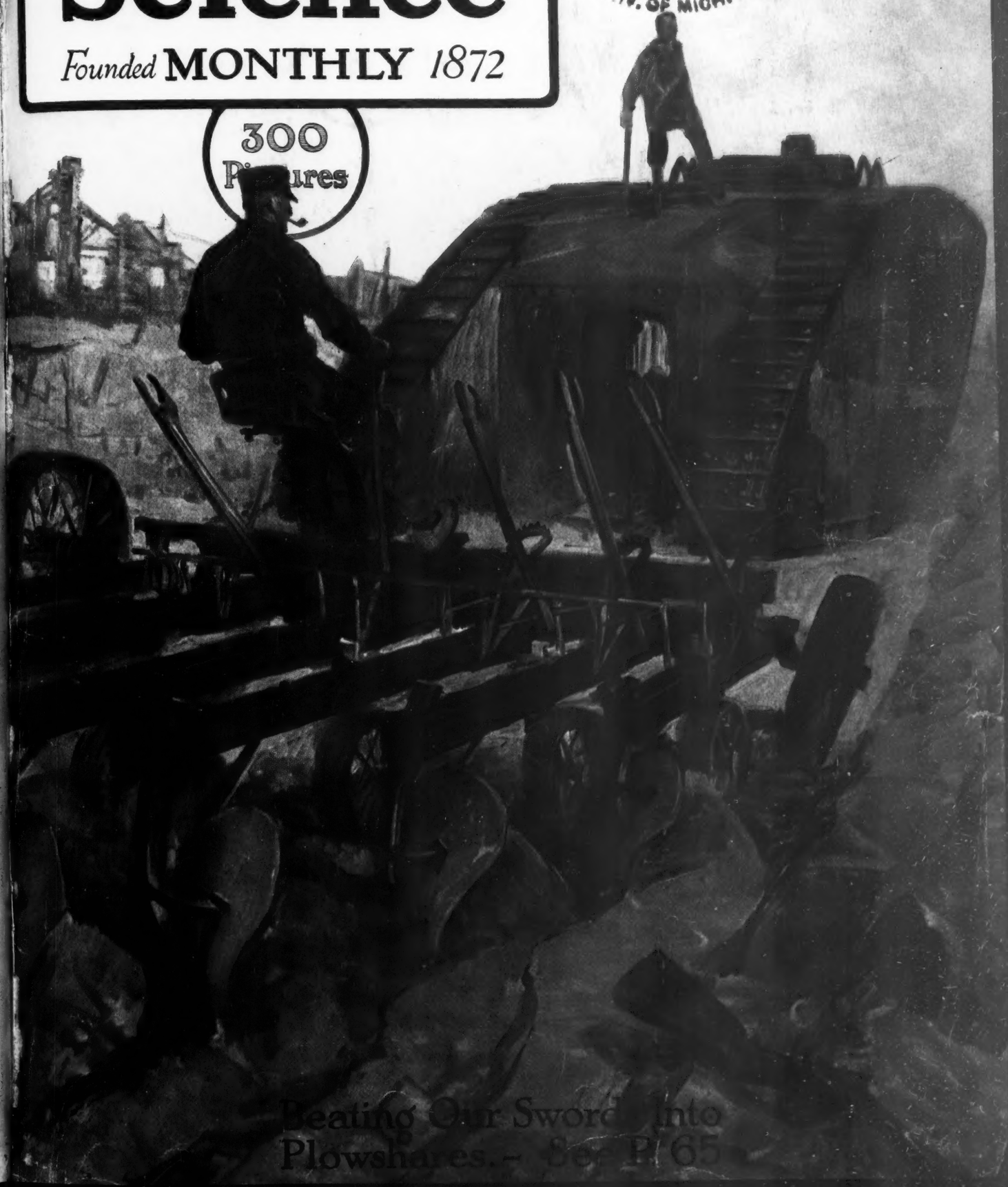
FEBRUARY Reg. U.S. Pat. Off. 20 Cents

Popular Science

Founded MONTHLY 1872

300 Pictures

GENERAL LIBRARY
FEB 24 1919
UNIV. OF MICH.



Beating Our Swords Into Plowshares.—See P. 65

FREE TRIAL

Keep it For $3.00 Per Month

Or Return It At Our Expense

The Oliver Typewriter—Was $100—Now $57

The Guarantee of a $2,000,000 Company that it Is the Identical Model

Be your own salesman and earn $43. You get the identical typewriter formerly priced $100—not a cent's alteration in value. The finest, the most expensive, the latest Oliver Model. Old methods were wasteful. Our new plan is way in advance. It is in keeping with new economic tendencies. It does away with waste. Inflated prices are doomed forever.

During the war we learned that it was unnecessary to have great numbers of traveling salesmen and numerous, expensive branch houses throughout the country. We were also able to discontinue many other superfluous, costly sales methods. You benefit by these savings.

Brand New—Never Used

Do not confuse this with offers of earlier models, rebuilt or second-hand. Note the signature of this advertisement. This is a $2,000,000 concern.

We offer new Olivers at half price because we have put typewriter selling on an efficient, scientific basis.

You can now deal direct—sell to yourself, with no one to influence you. This puts the Oliver on a merit test.

You Save $43 Now

This is the first time in history that a new standard $100 typewriter has been offered for $57. Remember, we do not offer a substitute model, cheaper nor different. But the same splendid Oliver used by the big concerns. Over 700,000 Olivers have been sold.

We ship direct from the factory to you. No money down—no red tape. Try the Oliver Nine at our expense. If you decide to keep it, send us $3 per month. If you return it, we even refund the outgoing transportation charges. You are not placed under the slightest obligation. That's our whole plan.

We rely on your judgment. We know you don't want to pay double. And who wants a lesser typewriter? You may have an Oliver for free trial by checking the coupon below. Or you may ask for further information.

Mail This Coupon Now!

An Amazing Book

All the secrets of the typewriter world are revealed in our startling book entitled "The High Cost of Typewriters—The Reason and the Remedy"—sent free if you mail the coupon now. Also our catalog. Order your free-trial Oliver—or ask for further information at once.

Canadian Price, $72

THE OLIVER TYPEWRITER CO.
1102 Oliver Typewriter Bldg., Chicago

NOTE CAREFULLY — This coupon will bring you either the Oliver Nine for free trial or further information. Check carefully which you wish.

THE OLIVER TYPEWRITER COMPANY
1102 Oliver Typewriter Bldg., Chicago

☐ Ship me a new Oliver Nine for five days free inspection. If I keep it, I will pay $57 at the rate of $3 per month. The title to remain in you until fully paid for

My shipping point is .....
This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name .....

Street Address .....

City ..... **State** .....

Occupation or Business .....

Popular Science Monthly

Waldemar Kaempffert, *Editor*

February, 1919; Vol. 94, No. 2
Twenty Cents; Two Dollars a Year

Published in New York City at
225 West Thirty-ninth Street

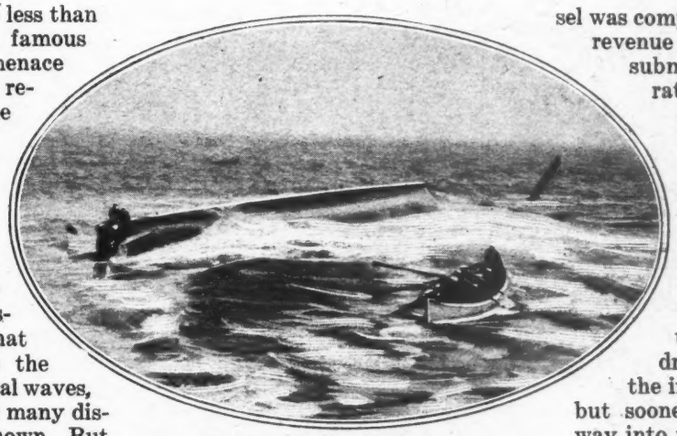
The Derelict—Rival of the U-Boat

How the Coast Guard fights the grimmest menace of the sea

By C. A. McAllister, Engineer-in-Chief of the United States Coast Guard

PEACE hath its perils no less than war—to paraphrase a famous saying; and, while the menace of the submarine has been removed by the victory of the Allies, the Coast Guard must continue its never-ending warfare against the derelict.

"Another chapter has been added to the mysteries of the sea"—how often have you not read that in a newspaper account of a ship that never returned? Such are the vicissitudes of storms and tidal waves, so-called, that the reason for many disappearances can never be known. But the men who sail the Seven Seas believe that derelicts, the grimmest menace of the sea in peace times, are responsible for many marine disasters.



Clinging to the slippery bottom of the derelict, they cut a hole in the keel for the towing-line

Such is the danger of the derelict that it became one of the leading subjects of discussion at an international conference of the maritime powers held at Washington in 1890. The conference recognized the importance of a systematic removal of derelicts from the paths of commerce, and adopted resolutions that something should be done. But after a few spasmodic efforts the Government again lapsed into indifference.

By 1906 the maritime interests of the leading Atlantic seaports appealed forcibly to Congress. An act was passed authorizing the construction of a special derelict destroyer, and the responsibility for systematically destroying derelicts was placed upon the Revenue Cutter Service, now the Coast Guard. The vessel was completed in 1907, and the larger revenue cutters were outfitted with submarine mines and other apparatus. For the last ten years the work of destroying derelicts has been vigorously carried on.

In general, there are but two types of derelicts: sunken and floating. Sunken derelicts, with their spars projecting above water, are generally found in the routes of coastwise traffic. Floating derelicts drift promiscuously about at the impulse of current and wind, but sooner or later find their devious way into the steamship lanes.

How many people realize that the waters along the greater part of our Atlantic coast, owing to the gradual slope of the bottom for a distance of thirty to fifty miles, are in many places not more than from ten to twenty-five fathoms deep? No wonder that when sailing-vessels, and even steamers, are sunk off the Atlantic coast, their spars project well above water—a menace to every ship that plies the near-by waters.

A boat from the cutter carries a line to the derelict schooner, which must be towed to land

In these days of radio communication it is not a matter of great difficulty to locate a wreck, and the nearest available cutter begins search at once. Even if the wreck is soon found the cutter must often "heave to" and await good weather conditions. The handling of gun-cotton mines and the

necessary detonating apparatus in small boats, tossed about in rough water, is not, as may well be imagined, the safest of occupations. Carefully the mine is secured to the projecting mast by a bridle, and attached to a water-proofed electric cable. Then it is allowed to slip down to the foot of the spar. Off rows the boat to a safe distance. One vigorous downward thrust of the magneto, and there is a dull roar. Hundreds of tons of sea water are cascaded upward. In the midst of the mass of glittering white water is the huge spar, jerked loose from its steel shrouds. Two, three, four, five, and sometimes six times the boat returns and places mines, depending upon the number of masts in the sunken vessel.

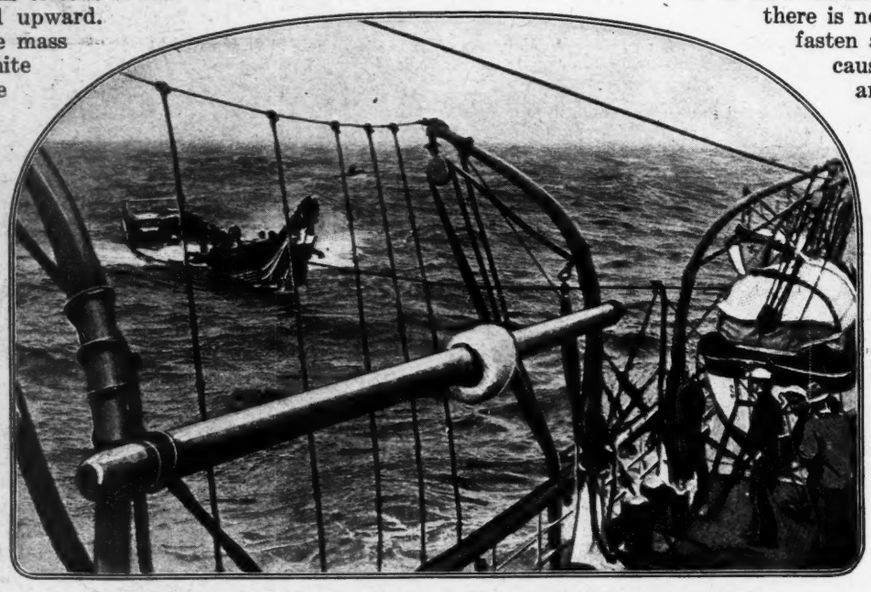
Wreckage Must Be Towed Away

Even when all the spars are blown up, the task of the cutter is not completed. Frequently the wreckage is tangled in steel stays and shrouds, which must be cut. The spars are usually lashed together and towed to shore. After all the spars in sight have been removed, soundings are taken over the wreck, and the information thus obtained is disseminated to shipmasters through Hydrographic Office bulletins.

Floating derelicts, although less numerous, are much more difficult to remove. The records of a decade show that fully ninety-five per cent of floating derelicts are lumber-laden, the timber in their holds keeping them afloat. Statistics also show that the stormy waters within a radius of one hundred miles of Cape Hatteras are responsible for most floating derelicts. Two cutters are stationed in that vicinity.

At first, attempts to locate these ocean waifs were not succcessful, but navigating officers have now evolved systems of search whereby failure has become less frequent. At first it was the practice to follow a zigzag course in the direction which it was assumed the wanderer might have taken. Searching after this fashion was mere guessing.

Nowadays the "spiral system" is employed. A cutter starts from the position where the derelict was last sighted, and from that point steers a series of courses approximating a spiral curve, the distance between the convolutions being equal to twice the radius of visibility, or the distance at which the object could be discerned from a lookout in the crew's-nest. In clear weather, and with portions of the spars on the wreck still standing, this radius can safely be taken as five miles, so that the distance between the convolutions of the spiral will be ten miles. Since a derelict must be sought in daylight, a lineal distance of about 145 miles can be covered in one day's cruising by the average cutter. In spiral cruising one day's searching under ordinary conditions will make it reasonably sure that the derelict is not within an area of 1522 square miles. On several occasions this method has met with success within a few hours.



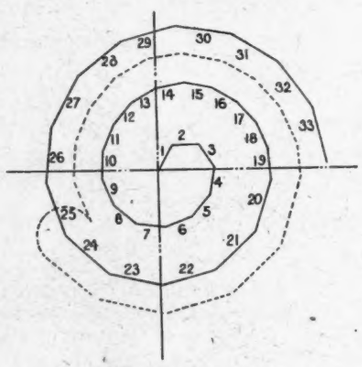
The boarding party from the cutter, after some difficulty, has gained a foothold on the derelict and is now making fast the towing hawser

Derelicts Towed to Port

Floating derelicts, when found, are not destroyed. In fact, it is almost impossible to destroy them. To blow the drifting wreck out of the way is simply to heighten the danger. Burning is usually ineffective; the upper works alone are consumed, because the seas extinguish the flames as they near the water's edge. There is but one sure way of removing these terrors from the seas. They must be tediously towed to the nearest port.

Most difficult of all to handle is the bottom-up derelict which has been capsized with all sails set. It is hard to find, because of the small amount of exposed surface above the water, and it is still harder to tow, because there is no place to which to fasten a tow-line, and because spars and resistant sails project from ninety to one hundred and twenty-five feet below the water. The boat crew must approach the slippery bottom of the derelict cautiously to prevent being dashed upon it by the sea. Picking their moment, they jump on the upturned craft and cling to the keel, the only projection available. Even then they are in danger of being washed off by some breaking sea. A long iron strap is fastened to the bottom of the keel by a number of ten-inch spikes. At the end of the strap is a ring through which the towing-line is secured.

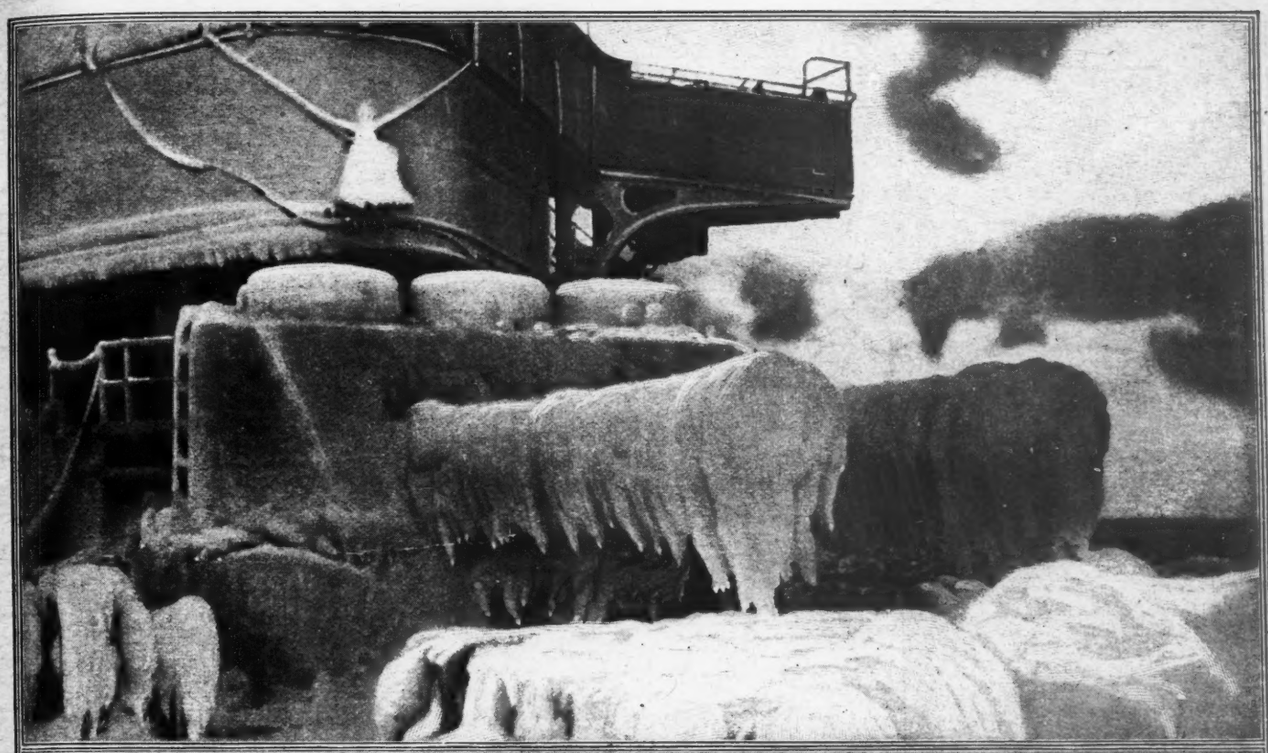
Towing is wearisomely slow. As the coast is approached the masts strike bottom and break off. Such wrecks are difficult to get into harbor, and so they are sometimes grounded and allowed to wash up on the beach in an onshore storm. Probably three fourths of all the floating derelicts recovered are repaired and put back into use.

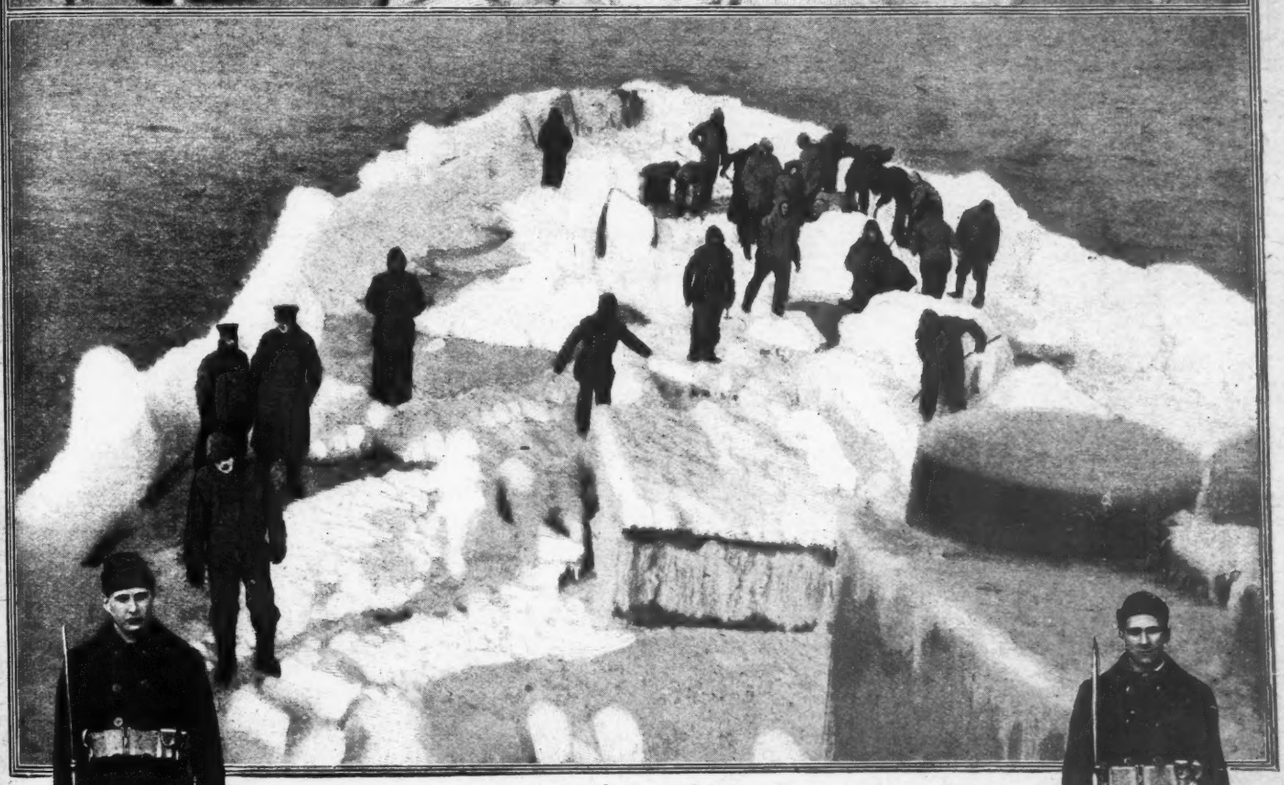


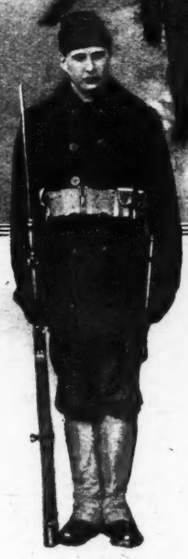
With a visibility of five miles, the cutter in a 145-mile cruise with a course laid out by the "spiral system" covers an area of 1522 square miles

An International Derelict Patrol

For the ten-year period ended June 30, 1916, covering the entire time in which records of derelict work have been kept, 268 derelicts have been destroyed or removed. At the International Conference on Safety at Sea, in session at London in 1913, brought about by the loss of the *Titanic*, the delegates from all the great maritime powers voted unanimously to invite the United States to undertake to rid the entire North Atlantic Ocean of derelicts. Unfortunately, before the convention could be ratified by the several governments involved, the war broke out, and the international derelict patrol was, temporarily at least, postponed.





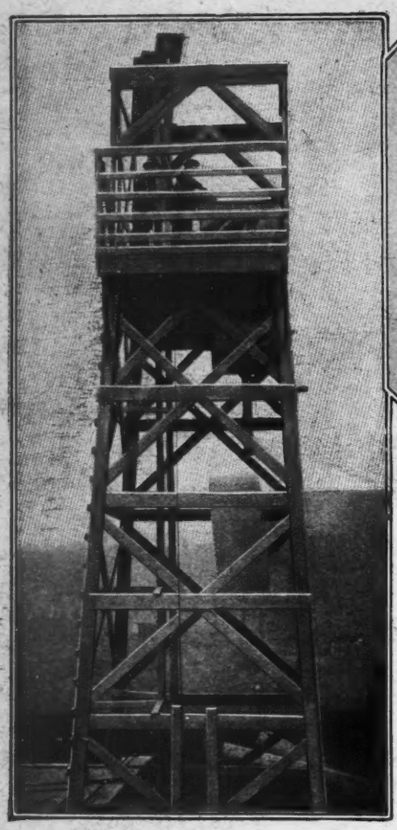


Photographs © Underwood & Underwood

All Hands! Repel Boarders!

Captured by an implacable enemy that returns to the attack year after year, this United States battleship is struggling to free herself. The great guns of the forward turret are spiked, the decks fore and aft are held by the enemy. It is time to sound the call: "All hands! Repel boarders!"

Such battles with Winter in his North Atlantic stronghold put hardened sea fighters to the test. The crew work swiftly to free the decks, but it is exhausting business in below-zero weather, when the flying spray freezes as fast as pick and ax can clear it away, and hot water from the deck hose is a welcome reinforcement. Many a time, in midwinter, ships come limping into port listing badly and all but overcome by the sheer weight of ice.



Treat 'Em Rough

THE men on the top of this derrick have just dropped a safe, which can be seen whirling through the air. What is more, when it hits the ground, half a ton of bricks will be dumped on top of it. Then, if it still survives, it will be baked for eighty minutes in an oven heated to 1,500 degrees. The men are quite hopeful of finding it intact after the eighty minutes are over, because they baked it just before they hoisted it to the derrick top. Its baptismal baking was not quite as severe as this second one, being for a period of only forty-five minutes.

These men are not dangerous ex-safe-breakers, nor inmates of a lunatic asylum, out on a spree—though one might easily think so. They are respectable safe-builders finding out just how much punishment their safe will stand for.

If it doesn't cave in after all this rough treatment, it is surely worthy of its name. And, even if it does, its survivors will be worth taking a chance on, for seldom are safes treated so cruelly in actual use. The worst of safe-breakers would treat a safe more mercifully than these earnest owners.

L'stening for the Whir of an Airplane Motor

THE characteristic purr of airplane motors was always a cause for excitement among children; and, now that the war is over and the sky is comparatively clear of airplanes, children miss them very much—particularly the two youngsters in the picture above. Their father had rigged up for them an outfit for detecting the sound of an airplane motor long before the ear, unaided, could catch the sound.

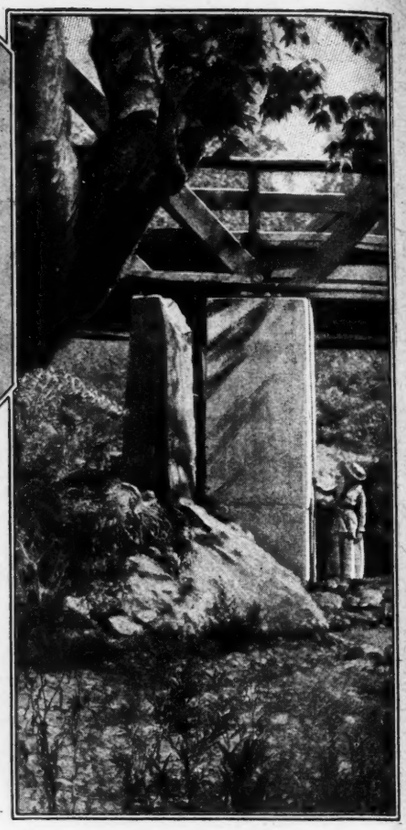
An old phonograph arm forms the basis of this mechanism. A large horn is attached to it, which is turned skyward to gather in sounds. At the other end of the arm a wire—instead of a needle—is attached which runs up into the head-gear. This head-gear, which fits the head just as a telephone receiver does, has two small magnets within it for reproducing the sounds.

Coasting on Dead Weeds

SINCE snow comes only in winter-time, most of us are content to do our sleigh-riding then. But not so the frisky folk shown here. One fine day in autumn, as they wandered about California, they happened on this hill. The tall weeds and grasses which had covered it in spring had died in the summer heat, and now lay smoothly on the ground.

The frisky ones got out their sleds and brought them to the top of the hill. One trip down proved that all the thrilling tumbles of sleigh-riding could be experienced on dead grass. Moreover, a tumble resulted in a healthy dirt bath instead of a chilly wetting.

Now all California has taken up the sport.



To Save a Tree

HERE is a magnificent old sycamore in Los Angeles that the people are trying to save. It stands just below the central piers of a bridge across the Arroyo Seco, at a point where the bank extends far into the "wash." The roots are exposed for many feet. Two years ago a reinforced concrete pillar was placed between the bridge-pier and the tree, and to it heavy timbers were bolted to form a bulwark against the mighty floods that sweep down from the mountains. But the waters formed an eddy behind the structure and tore the timbers out like paper. A still greater expanse of the ancient roots was exposed.

That effort having proved a failure, residents of the vicinity have devised another plan for saving the sycamore. They have placed a heavy pile of concrete, many tons of it underground, at the spot that bears the heaviest shock of the winter's flood.

A lot of time, labor, and money have been expended in trying to save this noble landmark, but it appears doomed.

Africa's Jitney Bus

IT costs only a nickel an hour to be toted around Africa, rickshaw fashion. This English officer has spent his nickel, and can now study in comfort the accouterments of his driver.

White paint alone relieves the gorgeous creature's feet of stark nudity. Beads and bands, big and small, reach from his waist to his neck. From the neck up he is surpassingly marvelous. A mass of white feathers form a background for two ferocious horns and his head.

Decorating the Graves of Fallen Aviators

ON this quiet hillside in France are buried many of the famous airmen who gave their lives that we might live in peace. And, now that world peace is secure, the greatest tribute is paid to the memory of those who made this so.

Here we see fellow airmen who survived the fighting, keeping fresh the graves of their fallen comrades. They have placed at the head of the graves, not the customary wooden crosses, but damaged airplane propellers, which, like the men at the head of whose graves they stand, fell fighting.

Each propeller has been finished off to resemble a cross, and each bears an inscription telling of him who lies below.

British official photograph

© Underwood and Underwood

He's Hugging Millions

THIS famous movie bad man William S. Hart, has just picked up one hundred million dollars. He invaded New York's Sub-Treasury one fine afternoon, wearing a Wild West hat, heavy riding-boots, and two large guns. These latter induced William S. Twiddy, deputy associate treasurer of the place, to open up bin 89 and offer to the other William S. the contents thereof.

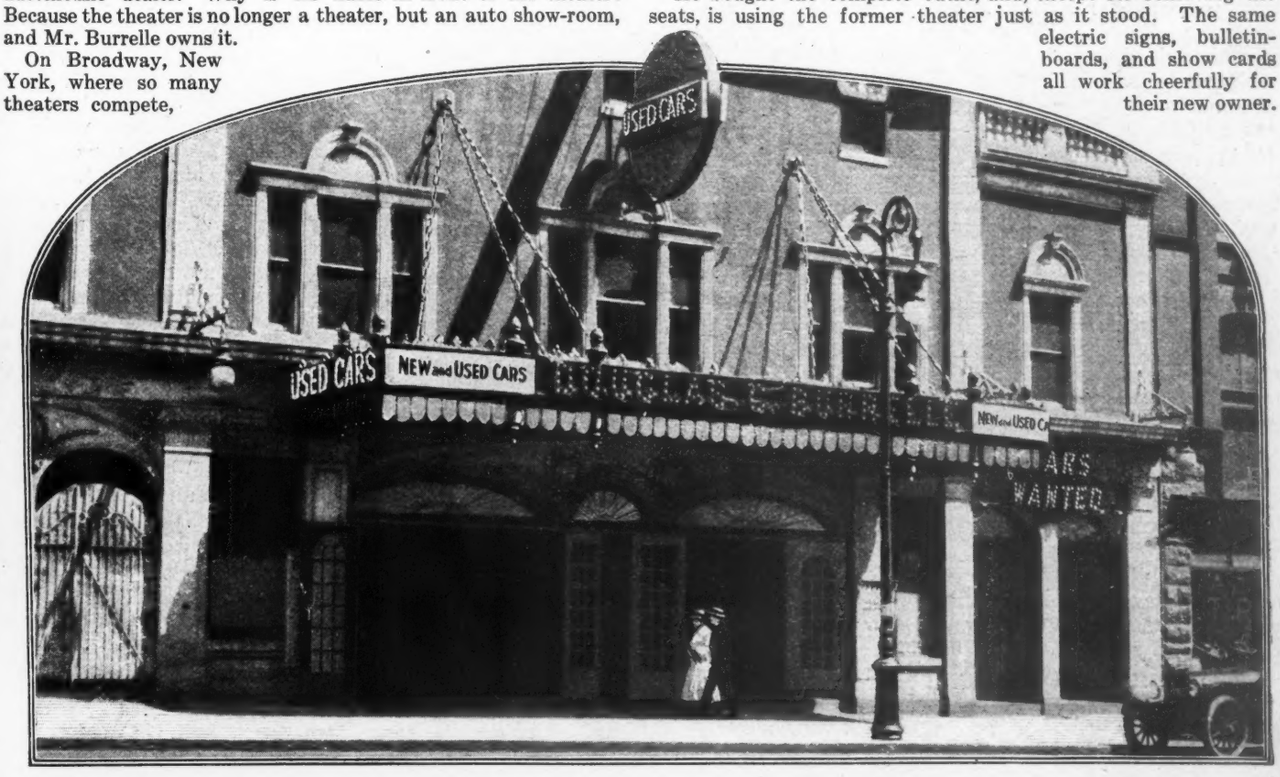
But what's a million more or less to Hart? Chances are, he won't even carry it away.

This Theater Is Now a Home for New and Used Cars

DOUGLAS BURRELLE is not starring to-night at this theater in his latest play, "New and Used Cars," as might be surmised from the picture below. He is not an actor, but an automobile dealer. Why is his name in front of the theater? Because the theater is no longer a theater, but an auto show-room, and Mr. Burrelle owns it.

On Broadway, New York, where so many theaters compete, some are sure to go under. This is one of them, and just at the time that it went, Burrelle happened to be looking for a gaudy show-room for his new and used cars.

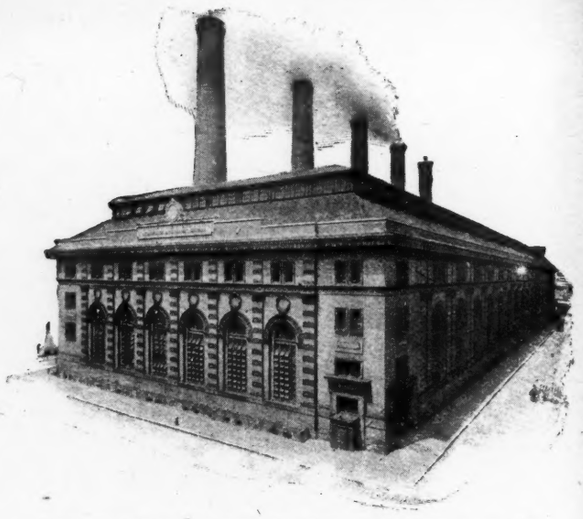
He bought the complete outfit, and, except for removing the seats, is using the former theater just as it stood. The same electric signs, bulletin-boards, and show cards all work cheerfully for their new owner.



What Next?

The Electromagnetic Gun?

But perhaps we have had our last world war



A big electric power plant like this would have to go with each electromagnetic long-range gun to supply the power

IF the bombardment of Paris from a distance of more than seventy miles served any useful purpose at all, it was that of calling attention to the limitations of modern artillery. Through the popular press of the country, the public has learned that every gun—and, above all, the huge piece that shelled Paris—is short-lived.

Sir Robert A. Hadfield, England's greatest steel-maker, once stated that the actual firing life of a gun is less than three seconds. Why? Whenever the gun is fired (and it can be fired scarcely more than two hundred rounds), the hot powder gases wash away the steel lining of the gun-barrel as if it were so much wax.

Apart from the difficulties encountered because of erosion, as this washing away of the steel is called, ordnance officers would hesitate about building a great gun because of other difficulties encountered. A range of more than seventy miles can be obtained only by enlarging the powder-chamber so that enormous charges of explosives can be used, and by lengthening the barrel for the purpose of enabling the powder gases to act for a longer time on the projectile. If the barrel is inordinately lengthened, special machinery must be invented to turn it.

Theoretically, there is no limitation to increasing the size, caliber, and range of guns; but it requires more than mere theory to build guns that are efficient for the purposes of war. Guns must be made of some material, and, unfortunately, there are limitations to the physical strength of every material known to man. Once upon a time guns were made of leather or wood; but, as the range and power of the guns was increased, stronger and ever stronger materials had to be found to resist the increasing strain.

Medium-Sized Guns Most Effective

In the last fifty years the evolution of artillery has made rapid progress. Chemistry, physics, metallurgy, and engineering were pressed into service and contributed their share to the marvelous development of this particular and most scientific arm. But scientists are inclined to believe that the limits of possibility in the evolution of the present type of ordnance has nearly been reached.

The building of bigger guns is limited by considerations of a technical nature. The larger the gun, the slower the fire. This is a serious drawback. Practice teaches that medium-sized guns are the most effective.

The monster guns of the most recent type are as big as can be built with the steel presses and converters now in use. To exceed the present muzzle speeds of projectiles, explosives of greater power must be found. However, the known laws of the expansion of gases do not suggest the possibility of obtaining a gas pressure behind a projectile that will propel it at an initial speed much above 4,000 feet a second. The erosive power of high explosives must also be taken into account.

The Electromagnetic Gun

Because steel is so easily washed away by powder gases, because big guns are so difficult to make, attention has once more been directed to the electromagnetic guns proposed from time to time by engineers.

The electromagnetic gun is extremely simple in principle. Any magnet attracts a piece of steel. Suppose that electromagnets were arranged in a row, so that the first would attract a steel projectile, then the second, the third, the fourth, etc., until finally the projectile would be hurled into space. It sounds very simple, doesn't it?

Several guns of that type have been invented and patented. As they are based upon the same principle,—a principle that allows but little latitude in the method of its application,—the guns invented by Professor Kristian Birkeland, Levi M. Bowman, Eli M. Alderman, Paul T. Kenny, Foster, and a few others differ mainly in the arrangement of the solenoids and in the method employed to cut out the electric current from the electromagnets after the projectile has passed them.

Professor Birkeland's invention, probably the most important of its kind so far patented, contemplates a gun-barrel made of bronze or steel, which is surrounded by solenoids. These solenoids are supplied with an abnormally heavy current, that is to say, a current beyond the capacity of the solenoids as calculated by the methods now in vogue for determining the safe carrying capacity of a coil.

According to the plan of the inventor, the heavy current that energizes the first solenoid is shut off by the projectile as it reaches the coils toward which it is drawn by the magnetic force of the solenoïd. At the same time, the next group of solenoids is energized. The magnetic force of the energized coils acts upon the iron projectile and adds to its speed; but again the current is cut off by the projectile before it has time to raise the temperature of the solenoid to a degree high enough to destroy it.

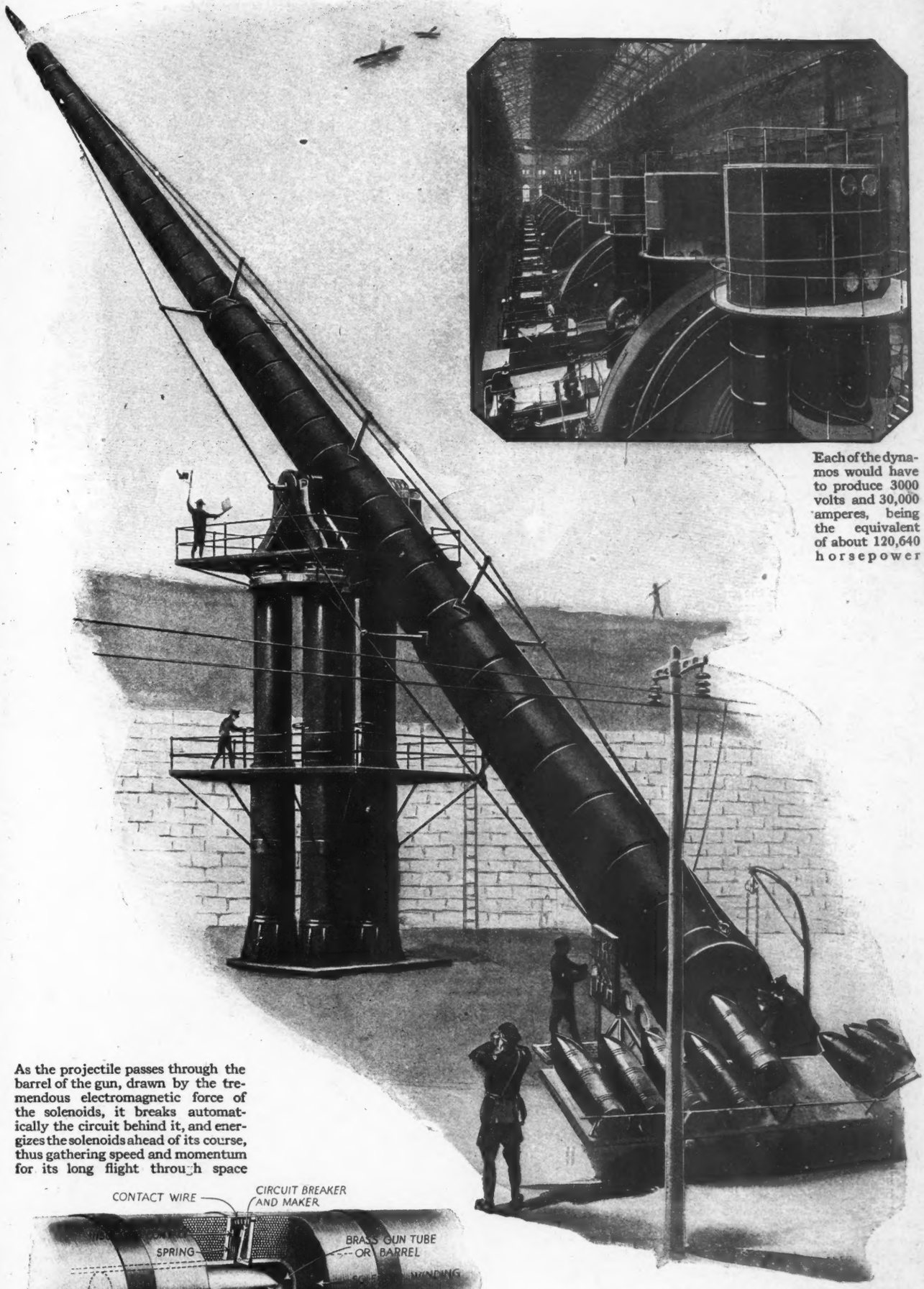
Is It Practicable?

The inventor calculates that for throwing an iron projectile weighing two tons and containing 1000 pounds of nitrogelatine at an initial speed of one thousand feet a second, a gun about ninety feet in length would be required. The projectile would be about nine feet long and nineteen inches in diameter. The gun solenoids may be made up of square wire, each solenoid containing 720 windings with a resistance of fifteen ohms. The length of each solenoid is made about three-eighths of an inch and the height about eight inches. With an electromotive force of 3000 volts, this will give a current of 200 amperes.

Major-General William M. Black, Chief of Engineers, U. S. A., does not believe in the feasibility of such a gun. At the thirty-fourth annual convention of the American Institute of Electrical Engineers, in June, 1918, he said:

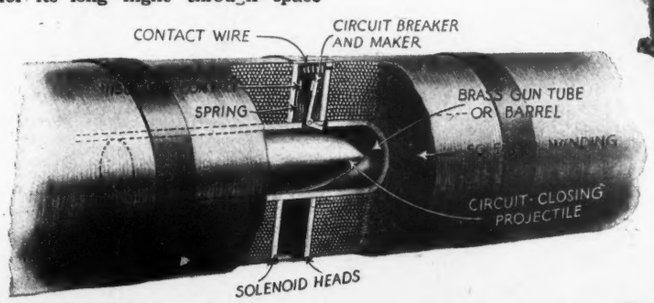
"You can understand the impracticability of transporting the electrical plants required for any number of such guns. I think that you will agree that, until new discoveries give a much improved method of storing or generating electricity, smokeless powder will continue to be the most compact and convenient form of stored energy for guns."

Each of the dynamos would have to produce 3000 volts and 30,000 amperes, being the equivalent of about 120,640 horsepower



Such would be the appearance and size of one of the electromagnetic guns of the Birkeland type if it were to be large enough to carry a large projectile a distance of one hundred miles or more

As the projectile passes through the barrel of the gun, drawn by the tremendous electromagnetic force of the solenoids, it breaks automatically the circuit behind it, and energizes the solenoids ahead of its course, thus gathering speed and momentum for its long flight through space

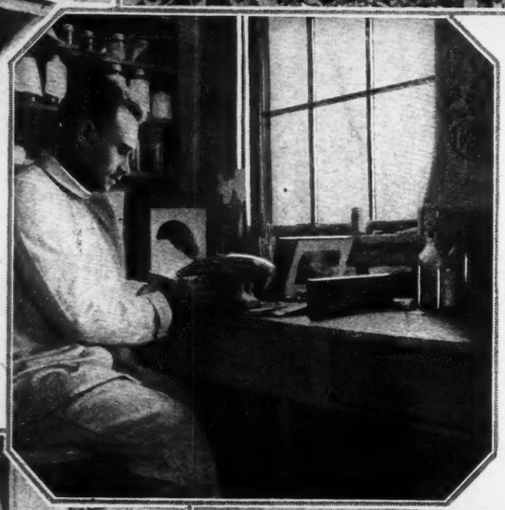


Soda-water fountain, 1918 style, in Mesopotamia. To keep the troops happy, the regimental factory worked overtime providing daily rations of two sodas for every man

© International Film

© International Film

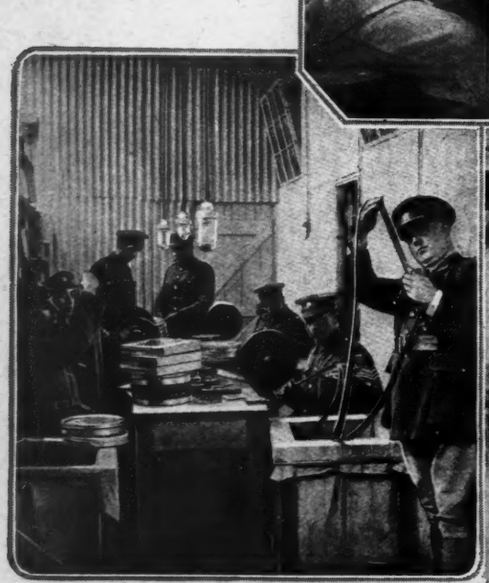
No, they are not hunting 'possum. These dusky experts and their white comrade are busy getting out building material for soldiers' huts or the makings for bridges



Private Kalisch enlisted to fight; but when the surgeons at Camp Sherman found he was a sculptor, they set him at work making models of unusual malformations discovered in examining thousands of men

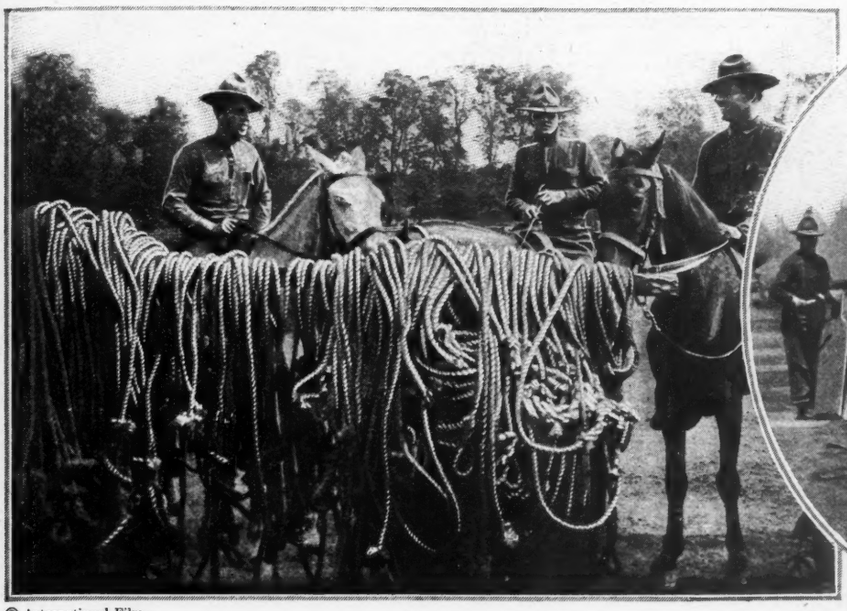
Soldiers Who Have

It's the men who seldom some of the most important



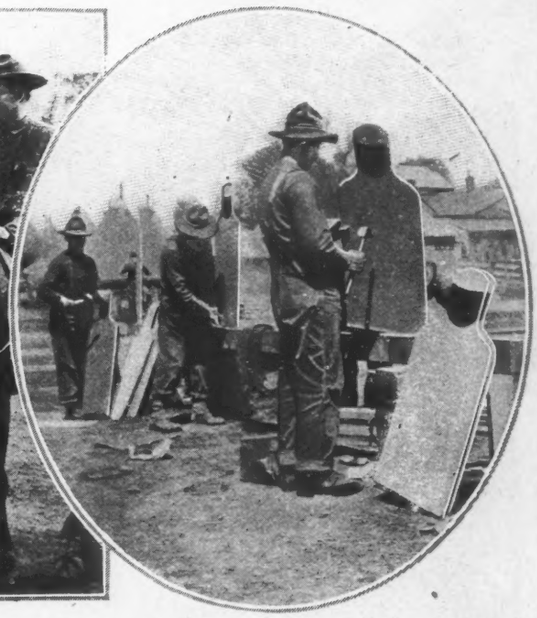
Looks like a job entirely removed from war's alarms—and it is. But you can't keep men up to fighting pitch without feeding their minds as well as their bodies, and the movies are the mental beans of the army. So we present these gentlemen whose war-time job it was to censor film instead of cartridges, and to make up a program calculated to appeal to the man just out of the trenches

Under the spreading shrapnel shower the army smithy stands. All, including Dobbin, look peaceful enough, but there's a real battle element in shoeing an army mule



© International Film

The cavalry got its chance in the war's last days; but what's cavalry but horses, and where would the horses have been were it not for these "wranglers" from our West, who can gentle a "bad hoss" and keep him fit?

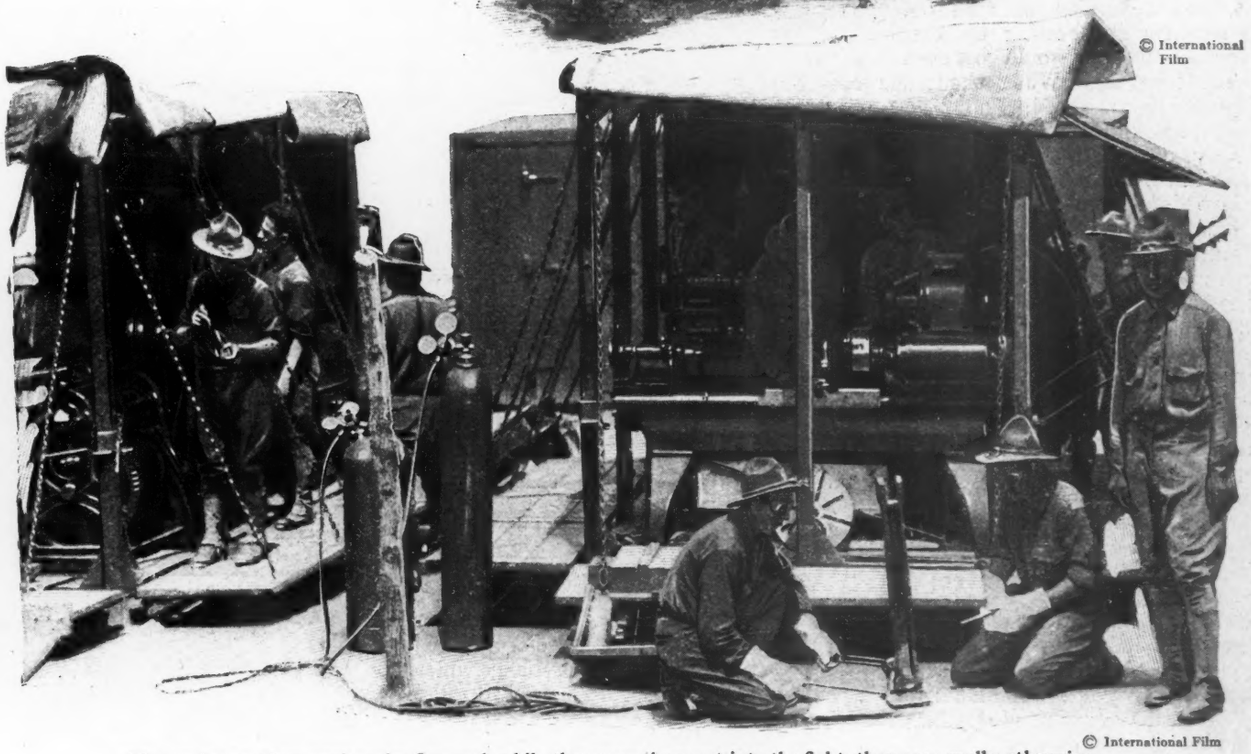


Soldier metal-workers made tin Huns to teach the young infantryman how to shoot. If you think their time was wasted, apply for particulars to W. Hohenzollern, general delivery

Never Pulled a Trigger

smell powder who carry on business of making war

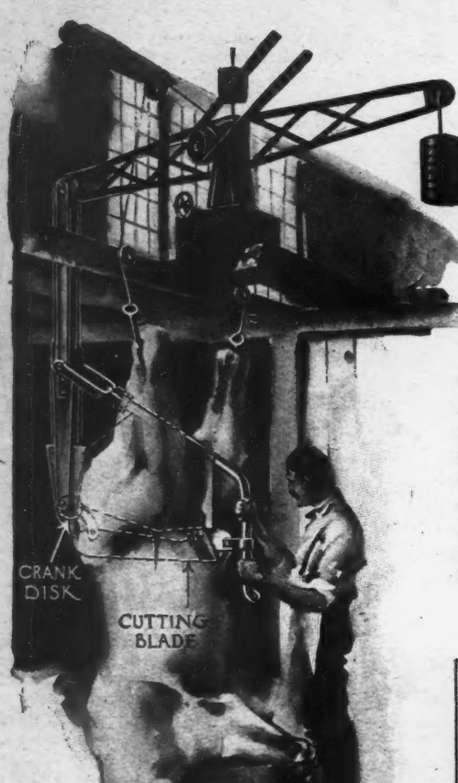
The "dashing messenger" of modern war is quite likely to be a meek-looking pigeon whose passion for home is relied upon to deliver the goods. These pigeons were the especial care of the signal corps



© International Film

© International Film

The engineers often work under fire, and, while they sometimes get into the fight, they are usually otherwise occupied. Here they are at work with a portable machine-shop equipped to tackle any man-sized job



Machinery propels the knife which, guided by hand, cuts up the carcass

A Machine that Is a Skilled Butcher

IF the saw, cleaver, and knife were the only implements used in slaughter-houses for cutting up carcasses, steaks and chops would cost even more than they do. When thousands of steers, hogs, sheep, and swine are killed and cut up every day, labor-saving machinery must take the place of the hand tool. Two New Yorkers, August and Charles Karhan, invented a machine which can be used even by a man who is not a skilled butcher.

Imagine a kind of see-saw or rocker. From one end a counter-weight is suspended; from the other the cutting implement. The cutting implement can be raised with hardly any effort. The cutting implement is so suspended from the rocker that no side movement of the cutter is possible.

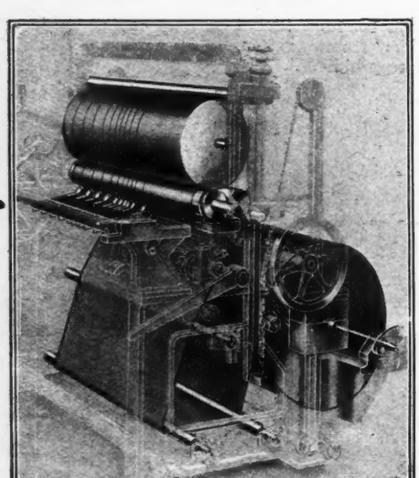
The blade is driven from a power shaft by means of a belt and pulleys. You have simply to grasp the handle and let the machine cut. It isn't even necessary to guide the blade; for the inventors have provided a point below the cutting edge which enters the spinal cavity in a way that prevents the knife from swerving.

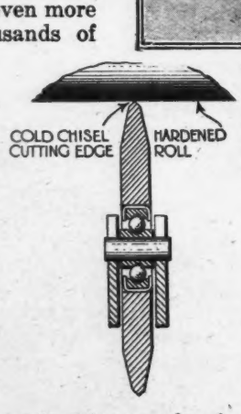
A New-Principle Paper and Fabric Cutter

CUTTING and winding "strip" or tape from broad webs of paper, fabric, and other materials was formerly accomplished by very crude methods. But recently the demand has been for more clean-cut products.

The manufacture of clothing, underwear, shoes, caps, etc., requires a vast quantity of cloth in strip form for bindings, trimmings, etc. Manufacturers of flags, automobile tires, typewriter ribbons, canvas belting, automobile tops, surgeon's bandages, and numerous other lines consume a great yardage of fabrics in the form of strip tape. Also the manufacture of electric apparatus consumes a large quantity of such material for insulation.

The paper trades especially de-



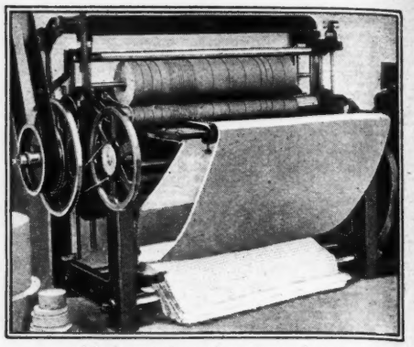


This machine unwinds a roll of paper, passes it between a hardened roll and a cold-chisel cutting edge, and afterward rewinds the strips thus cut

mand accuracy and speed, since roll paper must be cut for automatic wrapping machines, adding machines, recording and registering machines.

The machine that is illustrated above is the result of many years' work and experimentation to produce a clean cut through paper, fabric, felt, sheet, rubber, or composite materials. It will take paper or fabric from a roll, pass it through and cut it into desired strips, and roll it up again. The knives or cutting rollers, being made of a special steel with a V or cold-chisel edge which presses against a glass-hardened roller surface, cuts the material clean on the edges.

Because the cutting is accomplished by a cold-chisel action, the chance of the cutting edge becoming dull is out of the question. The machine is also constructed to take material from bolts instead of rolls. The uses to which this machine can be applied are unlimited, since almost anything to be made in strip form can be cut with it and rolled up in suitable packages.



After cutting the paper into the desired strips the machine arranges the strips in rolls

Lightening the Luggage-Carrier's Burden

FOR the benefit of the great army of "luggage-toters" fuming and fretting under self-imposed burdens, a carrying strap has been invented. It will carry luggage; but we prefer a wheelbarrow.

It is made of leather or canvas, and is used on either shoulder. The rear part of the looped strap has a widened extension, which rests against the shoulder-blade and back and is supposed to distribute the pressure of the burden. A pin fastening is provided to prevent the strap from slipping off the shoulder.

Carrying luggage ceases to be a terror if you use one of these shoulder-straps

A Box-Car Filled Every Ten Minutes

And it takes only two men to do the work that was formerly accomplished by a large force

FOR the sake of greater efficiency in handling coal at Baltimore, one of the greatest coal-distributing ports in the United States, the Baltimore & Ohio Railroad Company has adopted a system of loading and unloading, storing and handling coal, invented and patented by Francis Lee Stuart, formerly the chief engineer of the railroad.

The system comprises many novel features in the arrangement of the docking, storing, and distributing facilities, and the use of machinery for loading and unloading, which formerly was accomplished by a large force of shovelers, stevedores, wheelers, and other laborers, in addition to numerous locomotives for spotting and switching the coal-cars in the yards.

An Electric Loading Machine

One of the most important time- and labor-saving machines used in connection with this system is shown in the pictures. It is a loading machine driven by electric power, requiring the services of only two men—an engineer, who is stationed in the cab, and a loader, who directs the operations of the loading arm of the machine. One of these machines, with its crew of two men, can load a box-car with coal in ten minutes and an open or gondola car in less time.

The machine is used for loading the coal from vessels into railroad cars. The coal is taken from the hold of vessels moored to a long pier, and deposited, in hoppers which feed it to the thirty-inch main conveyor belt. This belt runs the entire length of the pier, is located between the rails of the main track, and is driven at uniform speed by electric power. The loading machine is mounted on trucks, and runs on the center track. It is driven by a motor, and can travel the entire length of the pier, so as to be brought in line with any car standing on the adjoining tracks on either side of the center track.

Getting the Coal on the Car

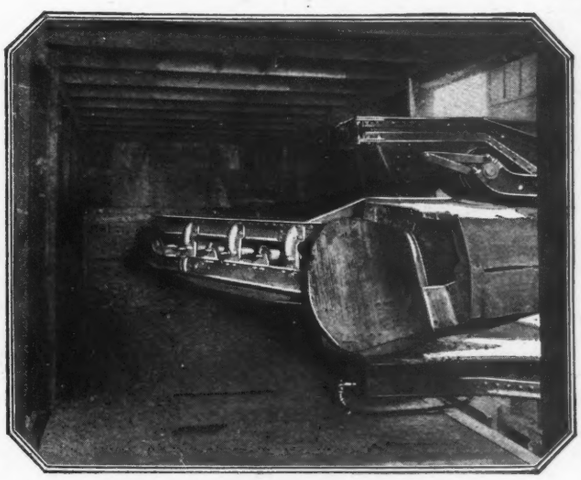
The conveyor belt runs through the loading machine, which is equipped with a twenty-inch intermediate conveyor operated by the motor of the loading machine. This intermediate belt carries the coal up an incline, and drops it into a hopper, which deposits it on the twenty-inch delivering belt of the loading arm.

The coal is automatically weighed as it passes through the loading machine. Before loading, the tonnage to be delivered to each car is determined. The register is set for one half the quantity, the loading arm is swung into position for loading one half of the car, and, when the predetermined quantity of coal has been delivered, a bell gives the signal to stop the loading. Then the arm is swung to the other side of the car and the loading is completed.

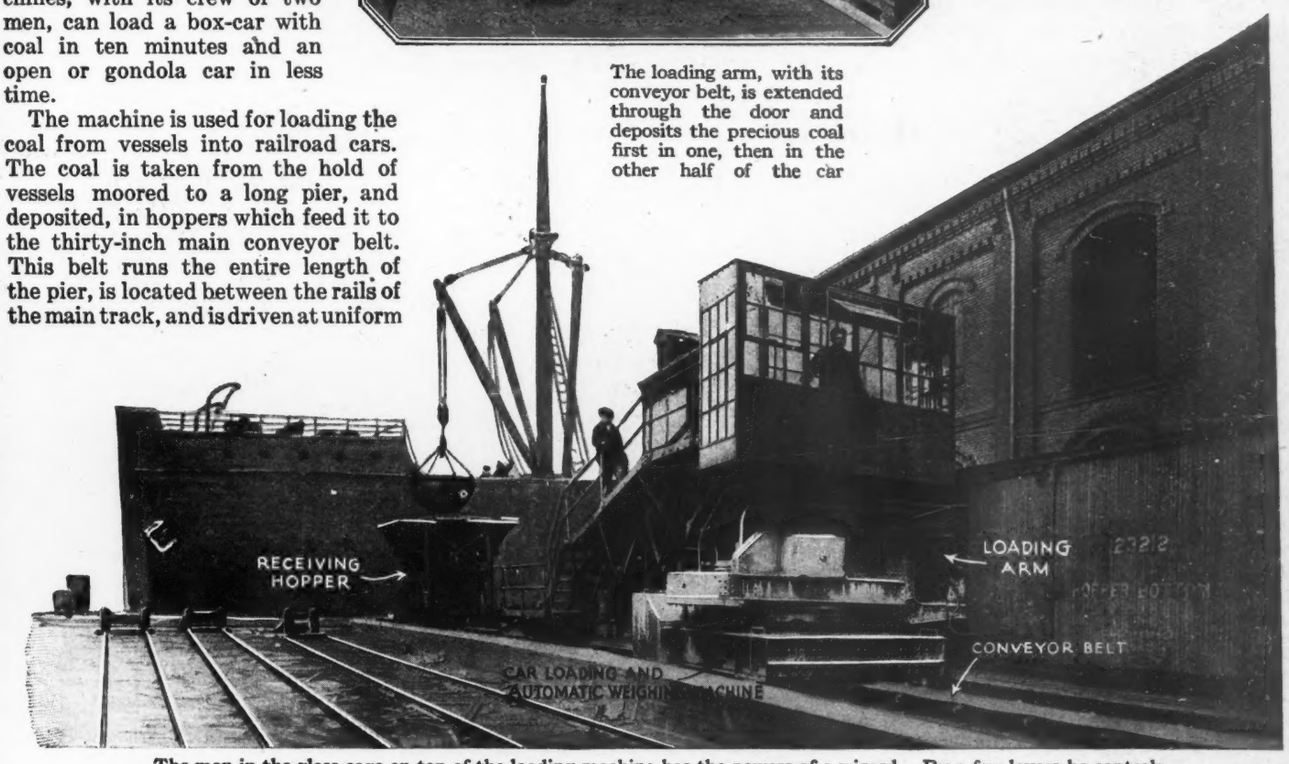
Control of the Mechanism

The control of the entire mechanism for driving the belts and for running the loading machine is located in the cab. The power is supplied by three wires strung along timber bulkheads between the rails of the center track. A fourth wire interlocks the main belt control and the control on the hoppers.

The loader is put in motion by the closing of a switch in the cab. The belts are started in their proper sequence. Provision has been made to stop all operations from any point along the pier in case of an accident or for any other reason.



The loading arm, with its conveyor belt, is extended through the door and deposits the precious coal first in one, then in the other half of the car



The man in the glass cage on top of the loading machine has the powers of a wizard. By a few levers he controls the entire mechanism of the conveyor belts, directs the movements of the machine, and operates the loading arm

A shadow phenomenon observed by aviators and invested by them with various superstitious meanings

Specters that Haunt the Clouds

THE accompanying picture represents an optical phenomenon that has been familiar from time immemorial to the birds of the air, but that has, until recent times, lain somewhat beyond the purview of humanity. Even at the present day, though it is well known to aeronauts, few of them are able to explain it or to give it a name. The picture shows the shadow of an airplane cast upon the clouds, and surrounding it is a ring of rainbow-colored light. The appearance of this light has been likened to that of the emblem painted on the wings of the Allied aircraft, and superstitious aviators regard it as an omen favorable to their cause.

Like the "Ring Around the Moon"

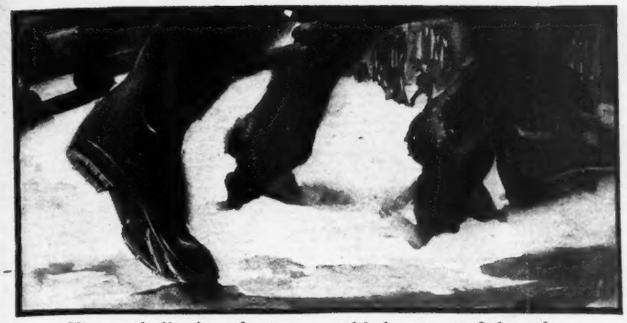
This phenomenon bears, however, a German name, for it is known as the "specter of the Brocken." True, the traditional *Brockengespenst*, which figures in German legend and in the narratives of mountaineers, is the shadow of the observer seen on a *vertical* bank of cloud or fog, and hence visible only when the sun is low; but it is identical in character with the shadows that balloonists and aviators see below them on a horizontal sheet of cloud, with the sun overhead.

In both of these cases the shadow may be surrounded with one or more rings of prismatic color,—the "Brocken-bow,"—though this is not always visible. This bow is due to light that is reflected back to the observer after penetrating the cloud a little way, and is broken up into its component colors by the water drops or ice particles. The process involved is called diffraction, and it is the same that produces the reddish corona, or circle of light, seen around the sun or moon when passing through fleecy clouds.

The weird shadows of themselves seen by mountaineers are often described as of gigantic size; but this is an illusion caused by the impression that the shadow is distant, when it is really only a few yards away. It would be interesting to know whether aviators cherish the same illusion concerning the shadows of their aircraft.

Our Picture Is Faulty

Another mistake about Brocken specters is perpetuated by the various drawings that have been made of them, including the one here reproduced. The mountaineer can see his own shadow, but he cannot see that cast by another person at a distance of more than a few feet from him. Similarly, the artist who made the picture above has drawn the shadow and ring as they appeared to the occupant of the airplane shown in the picture; but, from the assumed angle of vision of the artist himself, the phenomenon would have been invisible.



The anti-slipping cleats are molded as part of the rubber soles and cannot work loose under the hardest wear

Non-Slipping Shoe Soles

AN Idaho lumberman has invented the anti-slipping device shown in the picture above. The soles of the rubber boots are corrugated in the usual manner. Two V-shaped cleats, with the apex of the angle pointing toward the toes, are molded in the rubber of the soles and form an integral part of them. Another smaller and curved cleat is provided at the point of the toes, and a curved cleat conforms with the outside curve of the heels. Calks, provided with points, are set into the cleats of the heels and the V-shaped cleats of the soles. They are held in place by pins clenched upon the inner surface of the shoe sole.

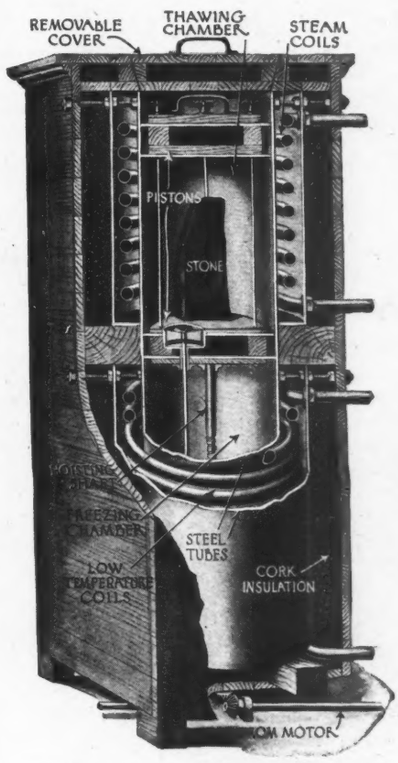
This boot has a layer of hot water inside which will warm the wearer's cold feet

Freezing Test for Sandstone

TO test the qualities of sandstone, the Bureau of Standards at Washington recently designed and set up a curious machine. Inside of a boxlike wooden structure from five to six feet high and two and a half feet square, a miniature elevator is raised and lowered by the revolutions of a threaded hoisting shaft driven by an electric motor. Walls, top, and bottom of the structure are well insulated with layers of ground cork and heavy boards. At the top of the inner chamber, surrounding the elevator, pipe is coiled, to be filled with steam under pressure. Similar coiled pipes occupy the lower half of the chamber, and are filled with ammonia vapors, to produce a freezing temperature.

By placing a water-soaked sample of sandstone on the elevator and subjecting it first to the freezing temperatures of the lower half of the machine, then raising it and thawing it out in the steam-heated upper portion, all the effects of alternate freezings and thawings, such as the stone might experience in the open, can be produced. Continuous operation of the machine makes possible as many freezings and thawings in a single day as would normally occur in two or three years. The disintegration produced, determined by weight, gives an indication of the stone's durability. Suitable partitions on the elevator prevent the air of the two halves of the inner chamber from intermingling. An electrically driven fan circulates air around the stone.

A clock operates the machine automatically, closing the circuit through the hoisting elevator's motor at definite intervals.



This machine gives sandstone as much wear in a single day as it receives outdoors in three years

Have You Got Cold Feet?

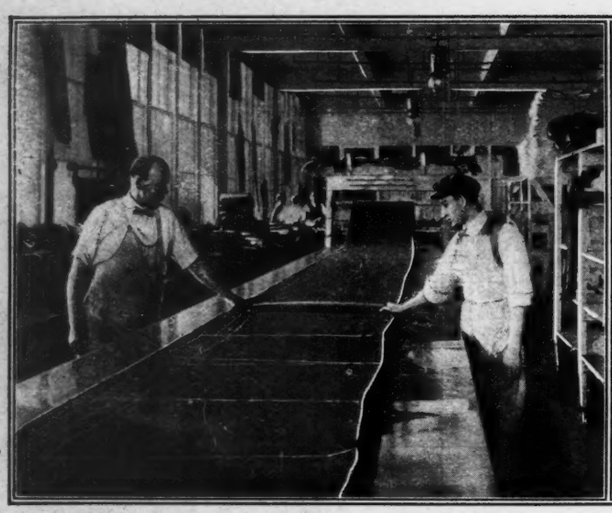
PEOPLE who suffer from literal cold feet, and who at the same time prefer comfort to beauty, will welcome this new cure—a hot-water boot. It is a large, clumsy affair, like a German soldier's shoe.

The inside casing is made of rubber, and fits the foot so snugly that air is excluded from the space between the foot and the casing. In this way the foot gets the full benefit of the hot water. To facilitate this the casing is arched and curved in just the places where feet arch and curve. Then comes the layer of hot water, and then the outside casing.

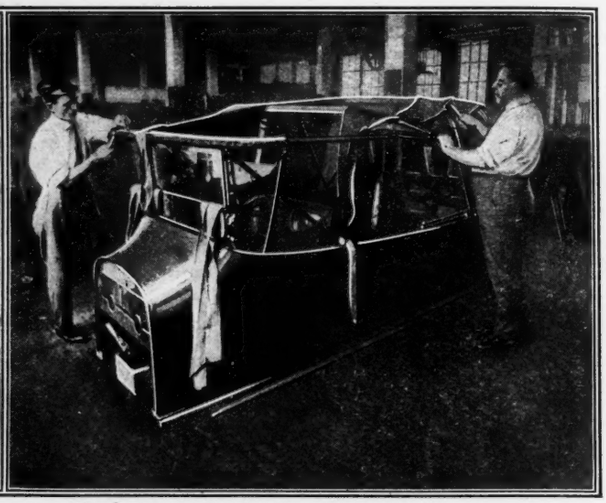
This outer casing is quite shapeless, the inventor's idea being to get it as far away as possible from the inner casing in order to give the water plenty of room to flow about in. It is, of course, fastened at the top to the inner casing, so that no water will spill over the edge.

The two casings are vulcanized together in several other places (toe, heel, and ankle), so that the outside one won't break when the wearer is walking. Hot water is poured in through a hole in the toe of the shoe, which is duly corked up when the shoe is loaded. Straps at the top of the boot insure a perfect fit in at least one place.

As to what happens when the water cools off the inventor says nothing. We assume that the wearer uncorks the boot, lets the water run out, and then puts his foot under the faucet for more. Or perhaps, like the farmer in our picture, he will fall asleep from the soothing effect of the warmth and be too far off when the water cools to care about it.



By this process it is possible to mark and cut out seventy-five or more layers of mohair at one time



Mounting and adjusting the automobile tops requires considerable mechanical skill and great care

Taking the Bumps Out of Automobile Traveling

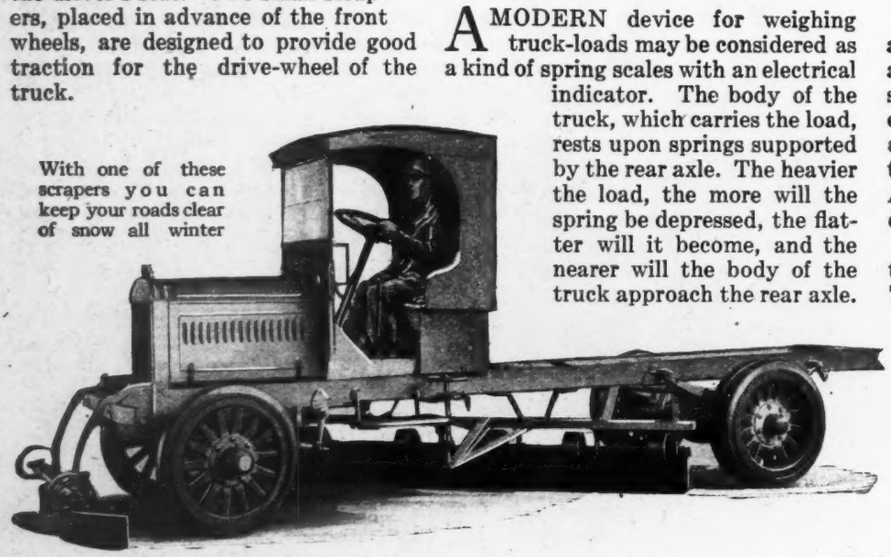
GOOD upholstery is one of the essentials of comfort in automobile traveling. Without soft cushions and a top that will keep the rain out, touring would not be a great pleasure. The pictures above show how some of the work of upholstering is done. The average seven-passenger automobile requires three large cowhides for the upholstery. An average skin contains sixty-five square feet of leather, but not all of this can be used for upholstering.

The automobile tops are covered with mohair. Huge rolls of the material are unwound and spread upon a cutting table until seventy-five or eighty layers have been spread. By means of an electric knife, keen as a razor, which the operator guides along chalk lines, the material for one hundred car-tops is cut out in a single day.

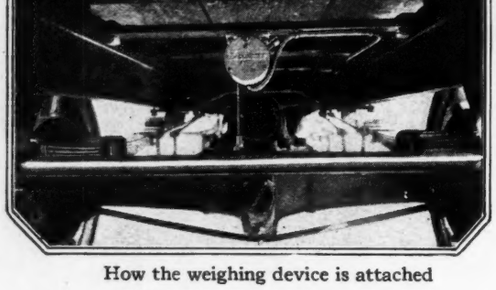
A Road-Scraper that Cuts through Snow

A NEW road-scraper which may be used for smoothing uneven dirt or gravel roads or for scraping a path in the snow for automobiles or other vehicles, is attached to a powerful automobile truck. The blade is twelve inches wide and is of carbon spring-steel. By six carbon steel springs the blade is suspended from a hanger board, which is set between the front and rear wheels of the truck.

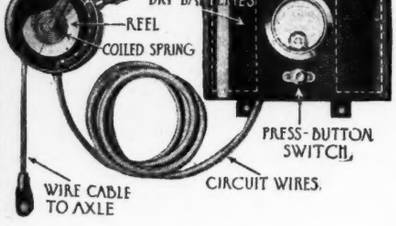
The scraper is hinged to a shaft, and can be raised or lowered by a chain and windlass operated from the driver's seat. Two small scrapers, placed in advance of the front wheels, are designed to provide good traction for the drive-wheel of the truck.



With one of these scrapers you can keep your roads clear of snow all winter



How the weighing device is attached



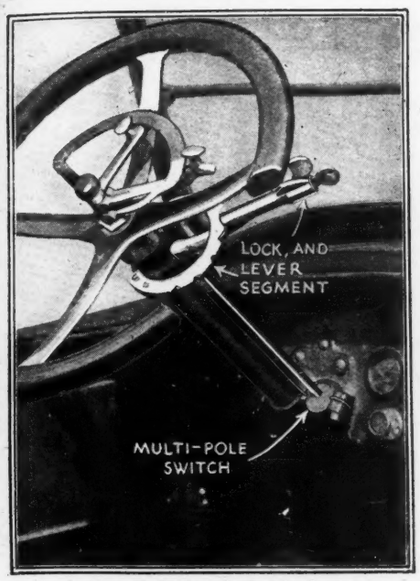
The rheostat drum is under the truck, the dial on the dashboard

Press the Button to Weigh Your Load

A MODERN device for weighing truck-loads may be considered as a kind of spring scales with an electrical indicator. The body of the truck, which carries the load, rests upon springs supported by the rear axle. The heavier the load, the more will the spring be depressed, the flatter will it become, and the nearer will the body of the truck approach the rear axle.

To the under side of the truck body, at a point directly above the rear axle, a drum is attached, containing a spring pulley to which is fastened one end of a small steel cable. The other end of the cable, which is held taut by the spring, is fastened to the rear axle. A resistance coil is connected with the cable drum, and revolves with it.

As the load is increased, the body of the truck moves nearer to the rear axle. The spring automatically winds up the slack of the cable by turning the pulley and the resistance coil. This changes the position of a fixed contact arm in relation to the resistance coil, and the change is recorded on a dial on the dashboard, if the current from two dry cells, turned on by pressing a button, is allowed to pass through the resistance coil.

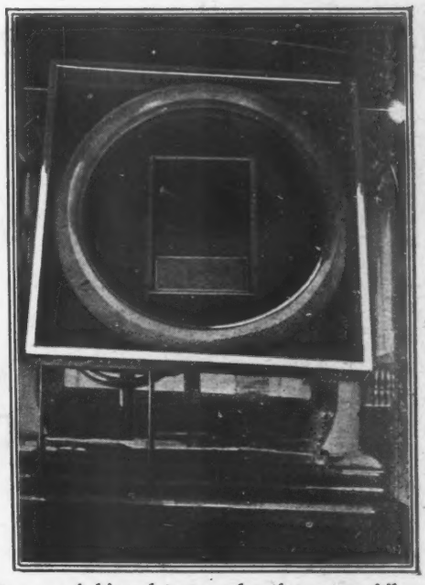


A turn of the key locks the lever, cutting out the ignition circuit

To Keep the Novice Driver from Accident

BEFORE the automobile novice has acquired proficiency it is not safe to intrust him with a car; but he must learn independence. An invention recently patented by Clifford M. Bishop, of New York, solves the problem by providing double control for cars used for instructing novices.

There are two steering wheels and brakes. The instructor's wheel is larger than that of the novice, while the diameter of the spur gear operating the brake-chain is smaller on the instructor's wheel. This enables the instructor to overcome the control by the novice to prevent accident.



A hinged tray under the automobile top for your spare tire and repair-kit

When the student automobilist becomes "rattled," the instructor can prevent accident

How to Block the Automobile Thief

A NEW method of securing an automobile against thieves is applicable only to cars provided with magnetic gear-shift. Ordinarily the shift lever can be moved to five positions — reverse, neutral, first, second, and third speeds. The inventor has added another position, the locking position, which cuts out the entire ignition system.

Stowing Away the Spare Tire

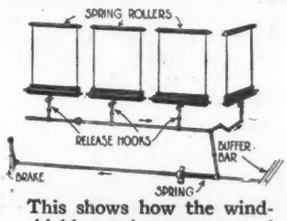
THE owner of a light delivery automobile with a top over the whole car hit upon a clever plan for stowing away an extra tire and some tools. He built a box of light boards for the tire, and placed in the center a smaller box with a sliding lid. Then he fastened the contrivance to a cross-brace in the top, back of the driver's seat.

No More Flying Glass when Automobiles Collide

WHEN an automobile collides with another vehicle or with a trolley car, both are often wrecked. Sometimes the impact is not powerful enough to break or disable the engines or to do any serious damage to the wheels, tops, or mud-guards. But even a slight collision will smash every bit of glass of the wind-shield and side windows. Very often the passengers are severely cut by the flying glass. This danger can be eliminated by fitting cars with automatic curtains behind the wind-shield and behind the glass side panels in case of a closed car.

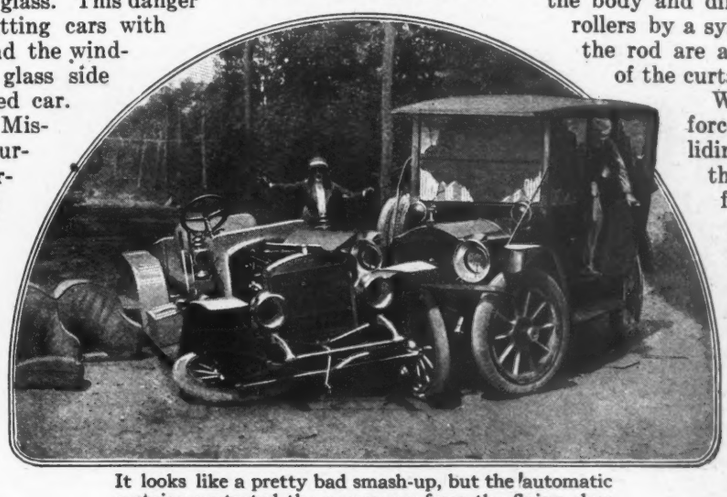
William A. Uttz, of Missouri, has invented such curtains, and they are operated automatically in case of a collision. They are connected with the bumper by a system of rods and levers. The curtain remains out of sight when not in use, and does not detract from the pleasing appearance of the car.

Each curtain is mounted on two rollers, one at the top and the other at the bottom, all inside of the body and behind the wind-shield. The curtains are normally wound around the lower rollers, and are provided with side guides to connect them with the top rollers without interfering with the driver's vision. Each curtain is operated by a rod extending back from the bumper alongside of the chassis frame. This rod operates a second rod inside the body and directly beneath the bottom rollers by a system of levers. Hooks on the rod are attached to the lower edge of the curtains.



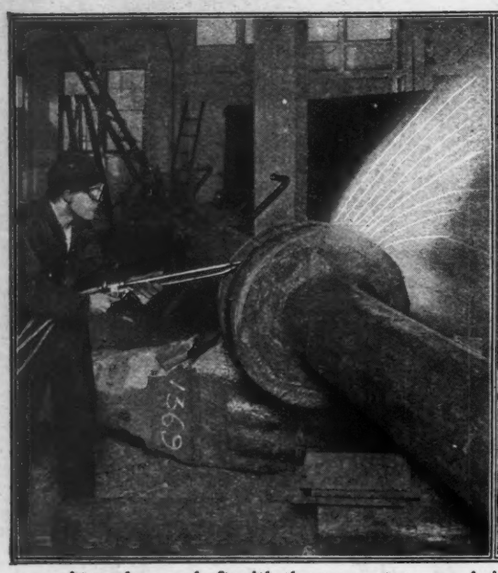
This shows how the wind-shield curtains are mounted

Whenever the bumper is forced backward by colliding with some obstacle, the inside curtain rod is forced back and the hooks released from their hold on the curtains. The springs in the top rollers then automatically raise the curtains behind the glass. At the same time, the current is cut off from the engine and the brakes are applied as an additional measure of safety for the passengers of the car.

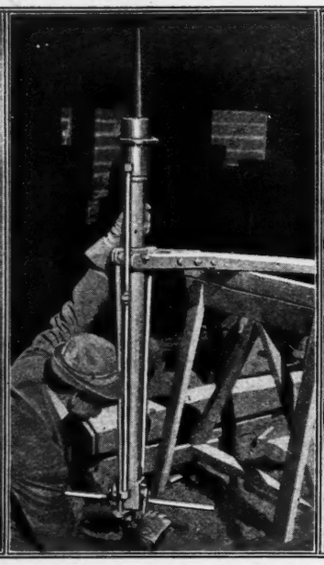


It looks like a pretty bad smash-up, but the automatic curtains protected the passengers from the flying glass

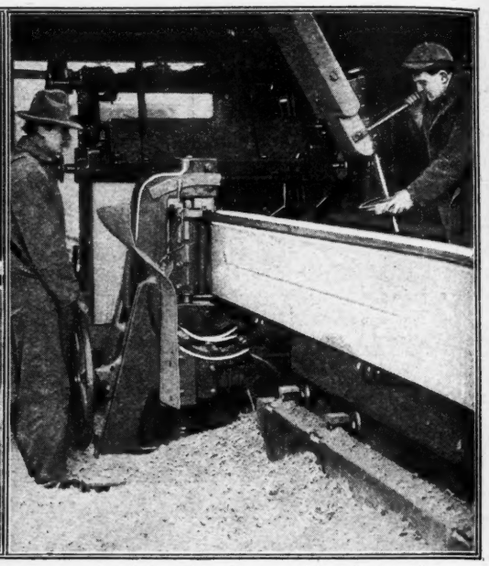
Labor-Savers that Helped Beat the U-Boats



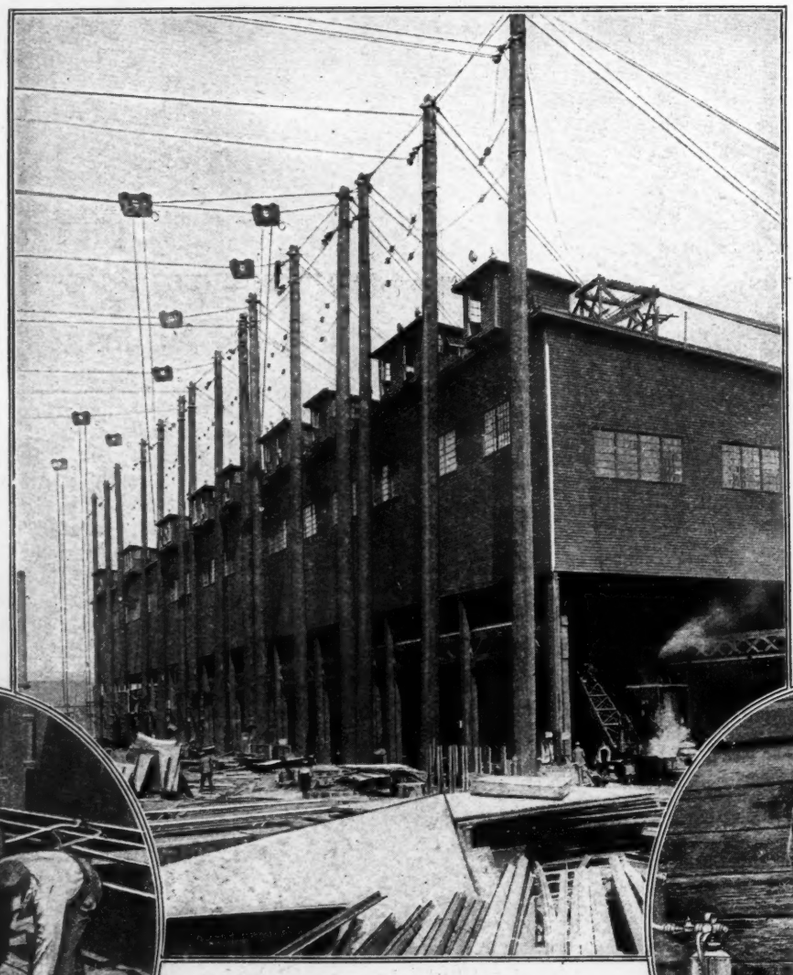
At work on a shaft with the oxy-acetylene torch. The powerful flame cuts steel as easily as a knife cuts cheese



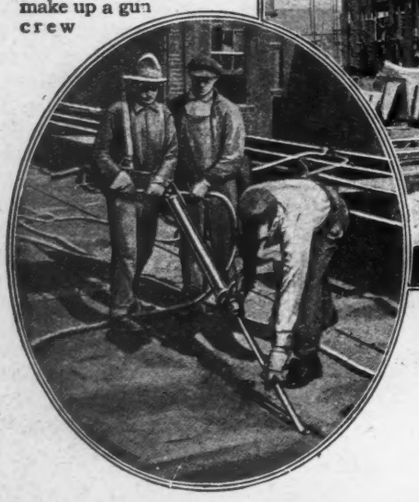
A rivet-cutting gun for punching out counter-sunk rivets. A bar is placed against the rivet-head and the gun does the rest



A side lead beveling-machine that works automatically helped speed up the fitting of a ship's timbers in war days



The slow and expensive sledge and cutting-bar method of getting rid of rivets and nuts that cannot be turned has given place to the air-operated cutting-gun, which works quickly and can go into action in a narrow space. Three men make up a gun crew



Tom Sawyer would have had an even easier time persuading the other boys to do his fence-painting for him if he had had this paint-spraying machine. It does the work of six men, and by its aid new ships get their christening suits as if by magic

This overhead cableway makes it possible to handle great quantities of material easily and quickly. Some idea of the size of the huge masts supporting the carrying cables may be obtained by comparing the masts with the man standing at the foot of the one at the extreme right

For Those Who Carry On

The service flag still waves and makers of novelties find many ways to display it

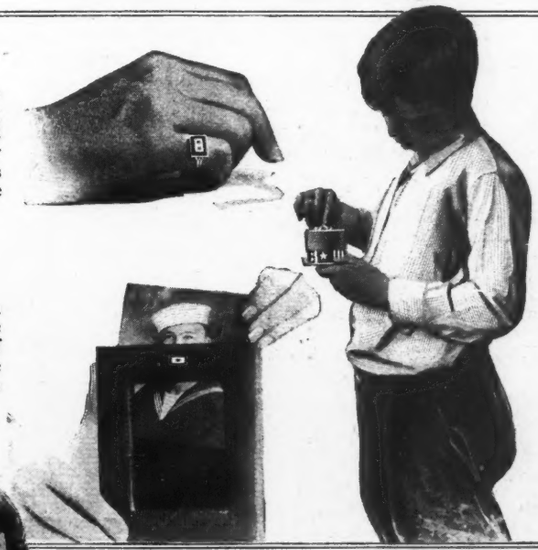
By post-card comes a blue service star on a silk back, and an appropriate verse asking the recipient to detach the star and wear it

For one who is still "over there" she wears this tie-pin with a star in the center of a red heart in a white field

This letter-case is bound in khaki, with a red, white, and blue service star on the covers. Inside the front cover is space to write the soldier's name, company, and regiment

There is also the service star ring —which is all right if your family of fighters is not too large

It's a service wrist locket, and of course his picture is inside. The star decorates the cover



A frame with a star to hold the photograph of the man in Uncle Sam's service

A candy-box for children is in the form of a traveling-bag with a service star on one side

His hat is in the ring, and his dime is in the hat; for it's a service bank, as witness the star on the band. It's a good way to get Tommy to save for thrift stamps

Big brother's photograph on the inside of a locket which carries outside of it a service star is sure to please the small sister

A bit young for the last draft, but ready for the next, he is equipped with a service star rattle made in the form of an Uncle Sam hat

How the Modern Steel-Furnace Does Its Work

What man has learned about handling the metal that gave civilization its start in life

By Ernest Welleck

WHEN primitive man, perhaps prompted by curiosity, picked a formless and heavy mass of a strange substance from the ashes of his camp-fire and, in trying to break it up by pounding it with a stone, found that this strange substance did not break, but could be hammered into any form, he laid the foundation of the framework upon which rests human civilization. For the strange substance was iron, which had been smelted from the iron-bearing rocks around which the fire had been built by chance.

In its various forms, as sword or plowshare, as tool, rail, or wire, nail or screw, engine, boiler, crane, magnet, battleship, or cannon, iron has contributed more to human progress and civilization than any other of the component parts of our planet. Its abundance and properties make it the most valuable—in fact, an indispensable—factor of practically every branch of human activity.

Getting Iron from Its Ore

Iron is a metal, but it is found in its metallic form only occasionally and in small quantities, principally in meteorites. It occurs most frequently in the form of oxides or carbonates—that is, combined with oxygen or with carbon and oxygen. These combinations yield the metal readily when smelted with carbon.

Until about 1860 only three important classes of iron were known—wrought-iron, steel, and cast-iron. Wrought-iron was almost free from carbon; steel contained between 0.30 and 2.2 per cent of carbon, and cast-iron more than 2.2 per cent. To-day a great many more kinds of iron and steel are distinguished. Their characteristic qualities are due principally to the amount of carbon they contain, the method of their production, and the presence or absence of certain other metals combined with the iron to form alloys.

In modern iron-works the iron is obtained from its ore in specially designed furnaces. These furnaces are about ninety feet high, and at their widest part have a diameter of about twenty-five feet. They are built of steel, in form like an elongated barrel, and are lined with fire-brick. The lower parts, in which the heat is greatest, are lined with hollow bronze bricks through which a rapid stream of water is forced. Under the furnace is the fire-brick basin in which the molten iron is collected, and from which it is drawn off. Another opening permits the slag to run out.

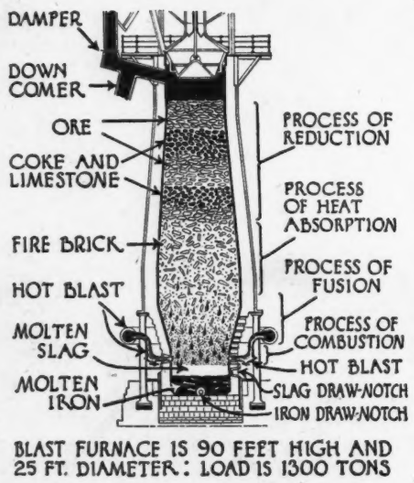
Four Hundred Tons a Day

The furnace holds about 1,300 tons, and is kept filled by adding layer after layer of ore, coke, and limestone as the mass sinks and becomes fused at the bottom. The temperature varies between 300° F. near the top and 3,500° at the bottom. The reduction of the ore takes place in the upper part.

The high temperature required in the production of iron is obtained by blowing into the furnace air previously heated in four stoves accompanying each furnace. These stoves, as big as the furnace, are of steel lined with fire-brick, and are heated to red heat. Only one stove at a time is used to supply the hot blast for the furnace, while the other three are being heated.

The molten iron is run into sand forms and cast into bars, called pigs. Each furnace produces about four hundred tons of pig-iron a day. The pig-iron contains a small percentage of carbon and a number of impurities, which must be removed before the iron is changed to steel.

For changing iron to steel two processes are principally used, the Bessemer and the open-hearth process. In the Bessemer process the iron is changed to steel in a steel vessel, about twelve feet in diameter and twenty feet in height, called a converter.

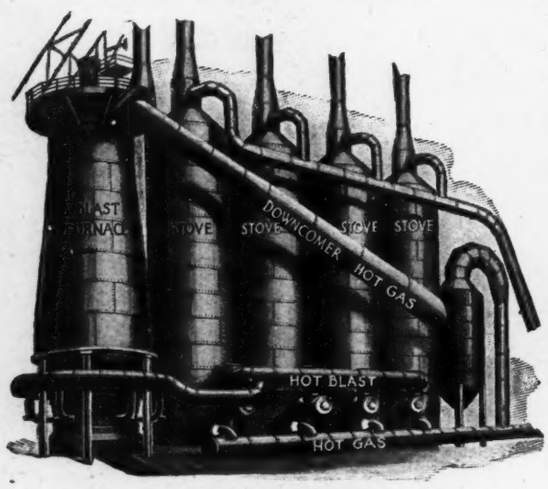


The furnace shown in this sectional view is capable of turning out 400 tons of iron every twenty-four hours

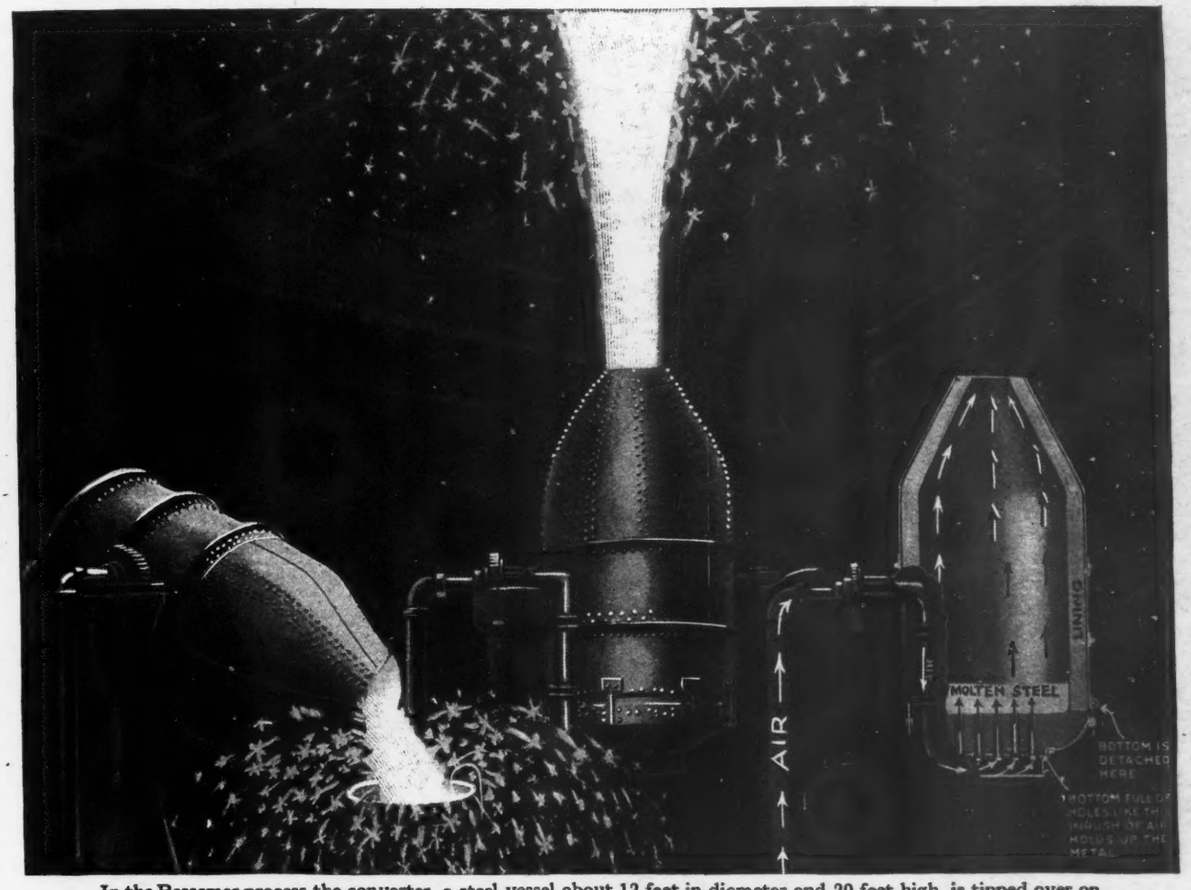
The Bessemer Process Converter

The vessel, which resembles a big bottle with the neck broken off, is lined with fire-proof material a foot thick, and has a removable bottom, through the fireproof lining of which a number of pipes extend into the converter. The vessel is tilted, and enough molten pig-iron is poured in to cover the bottom to a height of eighteen inches. Then a blast of air at a pressure of twenty pounds to the square inch is forced through the pipes in the bottom, and supplies the oxygen which oxidizes or burns up the impurities. By the addition of a weighed quantity of carbon, the iron is transformed into steel.

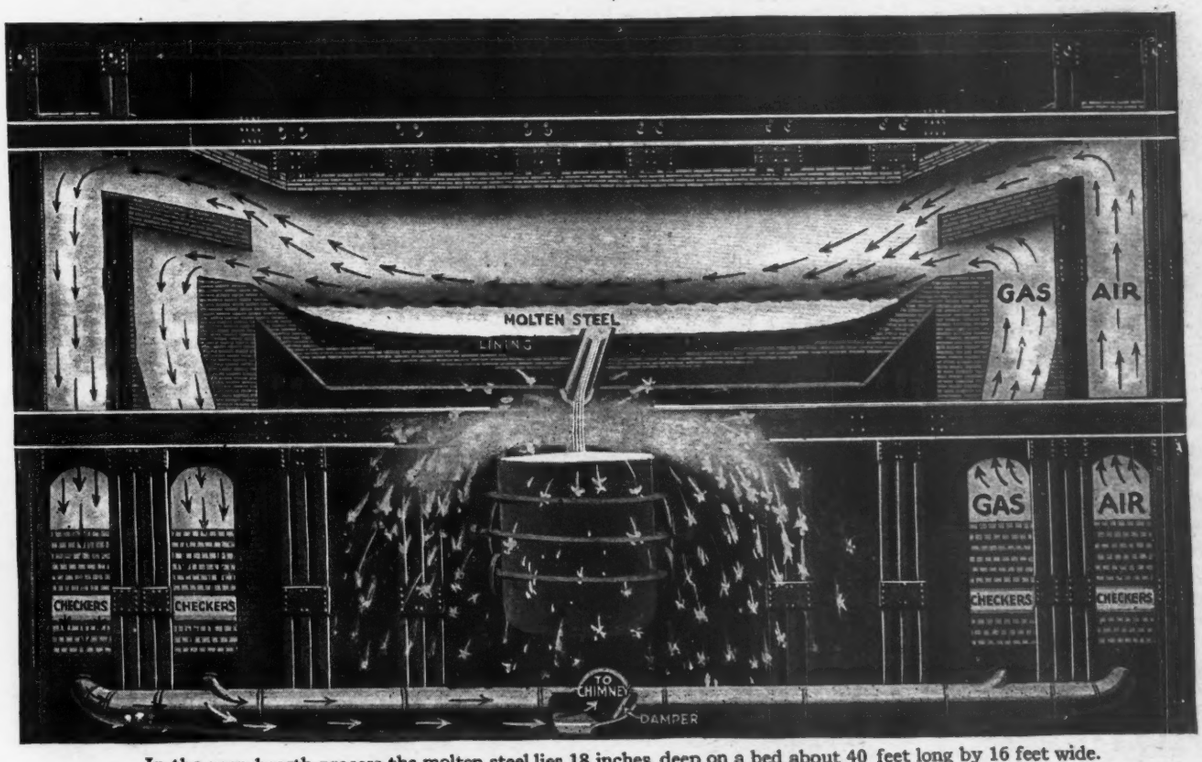
In the open-hearth process the iron is converted into steel in a saucer-shaped pan or hearth lined with magnesite, dolomite, and lime, and covered with a roof of silica brick. First a layer of scrap-iron is placed on the hearth, then a layer of pig-iron. Hot gas and air are forced into the hearth and over the iron. The pig-iron melts first, then the scrap-iron. The hot gases, forced over the molten mass, cause the impurities to become oxidized, forming a crust of slag on top of the molten iron. The pure iron thus obtained is then changed to steel by adding carbon, manganese, or whatever metal may be desired.



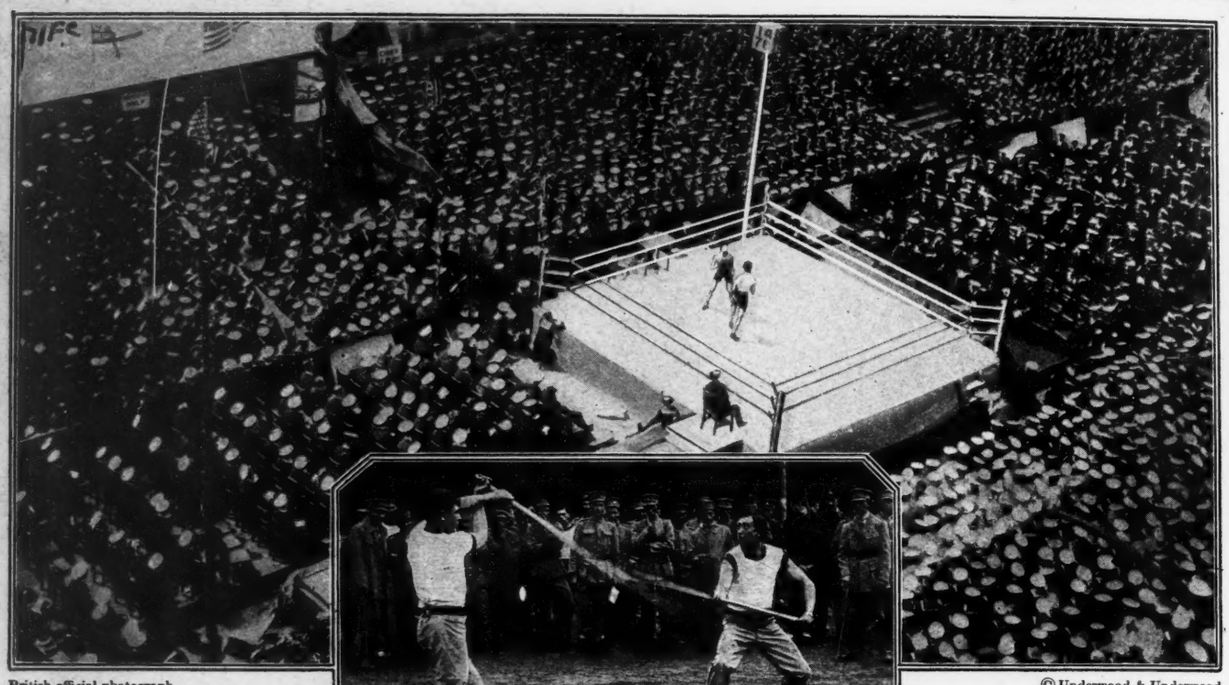
One furnace and four stoves furnish the initial heat for the blast. The stoves are heated red-hot



In the Bessemer process the converter, a steel vessel about 12 feet in diameter and 20 feet high, is tipped over on its side and molten pig-iron is run into its mouth; then it is turned upright and a blast of air is sent through it



In the open-hearth process the molten steel lies 18 inches deep on a bed about 40 feet long by 16 feet wide. Here the current of hot gas and air is shown being forced above and around the molten mass. Ore of less purity than that used in the Bessemer process is successfully dealt with by the open-hearth method



British official photograph

© Underwood & Underwood

Vacation-Time for the Boys in France

HOW will the boys of the Allied armies keep busy until they are mustered out of service? That is the question on many lips today. It is easily answered. They will have a gloriously good time—and it surely is due them. For these men have borne the chief burden of war, risking their lives, fighting the fight in its truest sense.

One would naturally expect that all their amusements would be far removed from the thoughts of fighting with which they might be supposed to be "fed up." But, strange to relate, no sooner had they finished hammering the Huns than they turned about and hammered each other in boxing matches, wrestling matches, and fencing bouts.

If you doubt the pleasure and excitement they get from these fights, look at these two pictures. There can be no doubt about the intense interest in the fight of the thousands of British sailors who are watching it, for not one of them has turned to look at the photographer. And as for the two fellows who are having a bout at singlestick, they could not have looked more fiercely interested when they were bayoneting Germans but a short while before.

Their audience is most responsive.

The Squirrel Takes to the Bottle

THIS little bottle-baby is an orphan only two weeks old. When his mother died he would have followed suit if somebody had not given him his chance by feeding him milk from a doll's bottle.

The eager way in which he goes to it, holding the nipple with his front paws, is a reassuring indication that he will make good and grow to full-sized squirreldom, though his body now is pitifully thin and very much out of proportion.

In spite of his appetite, we may be sure, from the sad droop of his mouth and the wistful look in his eye, that he is truly mourning his loss.

A Box-Car that Is Now a Schoolhouse

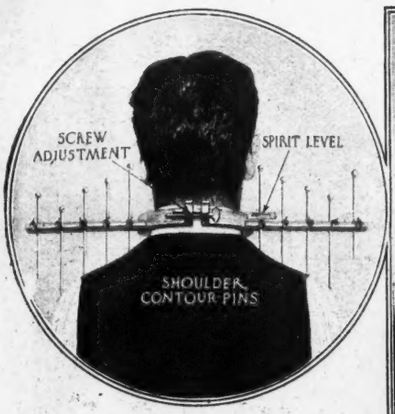
THE little red schoolhouse has been revived in the heart of Death Valley; but it isn't a building standing in the shade of a green grove. It is a faded box-car out under the burning sun and in the path of driving sand-storms, at the little town of Tecopa, in Inyo County, California.

It was discovered that at Tecopa a group of children well past school age had never seen the inside of a schoolhouse. When the town petitioned the county for school facilities, the authorities had difficulty in finding a suitable building. Then the superintendent of the Tonopah & Tidewater Railroad came to the rescue with the box-car. The pupils are apparently perfectly satisfied with it.

Alas—This Poor Doggie Had None!

HE was born into the world without the usual allotment of dog-feet—two forepaws he was shy. As he raised his moist, appealing eyes to his owner, that kind person had not the heart to kill him. Instead, he bought two rubber-tired wheels, and made them serve as paws by strapping them to the dog's body where the paws should have been.

The playful pup philosophically made the best of his artificial limbs, and can be seen any day playing with more fortunate comrades on the streets of his home town, Jacksonville, Florida.



Going Under the Tailor's Yoke

GOING under the yoke in Caesar's day was a token of submission. Recalling that, and admitting that most of mankind is submissive to its tailors, it is easy to see how Edward C. Berriman, of Chicago, got the idea for what he calls a "shoulder-yoke," which, in the language of the Patent Office, is "a device for accurately determining the width of collar and slope of the shoulders of an individual."

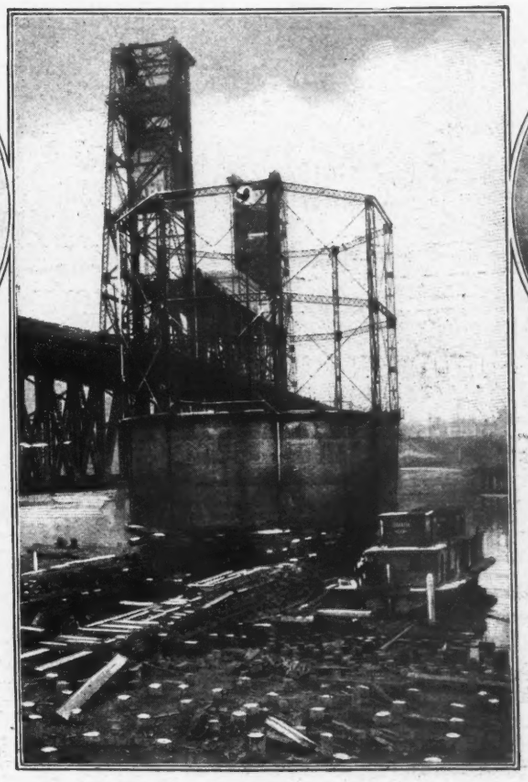
The tailor clamps the neck-piece around the neck of his customer, glances at a spirit-level attached to the yoke to make sure that the arms are level, and adjusts the pins to mark out the shoulder curve. Then it's all over except coming back next week for the try-on.

They're Choosing Pet Crickets in Cages

TO us a cricket is but one of the tribe of noisy insects that visit us each summer, predicting hot weather, and so unloved. Not so in Japan. There he is a household pet.

Caught by cricket-venders, he is placed in a fancy cage and sold to an admiring public. Solitary confinement soon starts him shrieking for his lady-love, and the house is filled with music.

Of course you know that a cricket's song is made by rubbing the smooth side of one wing against 130 ridges on the under side of the other one.



A Gas-Tank's Moving Day

A gas-tank 75 feet high and weighing 250 tons, with a capacity of 150,000 cubic feet, was recently loaded on two barges and towed to a point half a mile up a river, where it was needed on account of the increased quantity of gas used in the construction of ships.

At the point that the tank left the street for the trip down the bank to the barges, the cribbing was built up to a height of 19 feet, a difficult feat because the bank consisted mainly of sawdust.

Two barges lashed together, preparatory to the trip up the river towed by tugs, were the danger point. It was seen that the barges would list heavily if the load were rolled on directly from the staging. To counteract this, cantilevers were constructed, and the weight placed in the center of the barges. Only 7 inches list was registered when the load was applied.

During this procedure all passing boats cut off their power and drifted by to minimize the wash, which would have literally upset all the work that had been accomplished.

No difficulty was encountered. The tank arrived at its destination, was placed on shore, and was jacked up 22 feet to the top of a solid sand bank, where it is now working satisfactorily.

They Look Enough Alike to Be Twins

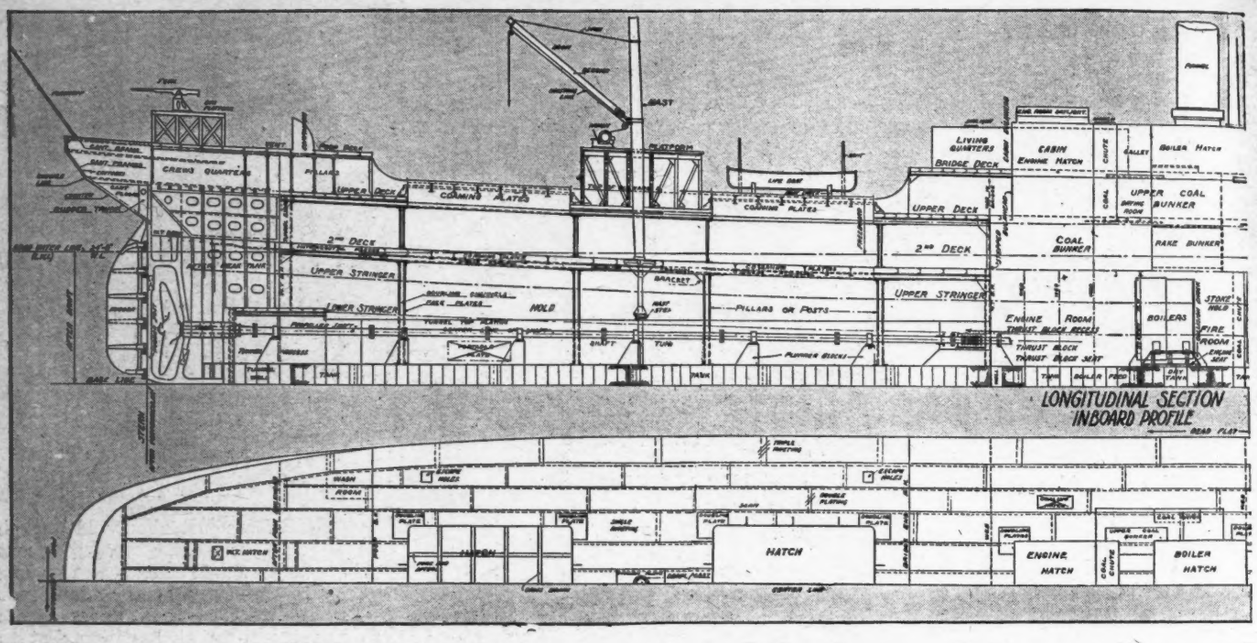
THEY are just about old enough and their claws are just about strong enough to enable them to hang on to the cigar of their indulgent master. Their scraggy appearance is not due to rough handling, but to the fact that they are passing through the half-feather-half-fuzz stage. When they grow up they will be proud, haughty canaries; just now they are simple, trusting babes who know not the perils of sitting on a lighted cigar.

The canaries of the tribe to which these two belong are great mimics. They will mimic the song of any bird they hear. Therefore wise breeders keep them near nightingales when they are learning to sing. A canary with the voice of a nightingale is worth much money.

All Hands Sing the "Star-Spangled Banner"

WHEN normal Americans are seized with patriotic fervor, they stand up and shout the "Star-Spangled Banner"—perhaps a bit shaky on the top notes, but ending bravely on "the brave."

The deaf and dumb are deprived of this means of self-expression, but does their patriotism go begging? One look at the smiling seven shown below will reassure you. They are singing "Oh, say can you see—" and all that follows, with their hands. As they sing, a band plays the music and a teacher keeps time for both.



The Anatomy of a Modern Ocean Camel:

WHEN the United States entered into the world war, it caused a demand for shipping facilities without parallel in the history of the world. The transportation alone of an army of three million men from one side of the Atlantic Ocean to the other was a tremendous undertaking.

Assuming that every transport could carry an average of 5000 men—rather a high estimate—it would require 600 shiploads. But that is not all. An army needs clothing and provisions, arms and other equipment for fighting; and the stores of provisions, clothing, and war materials must be constantly replenished.

In England, as well as in the United States, cargo-carriers were built in the shortest possible time. By selecting several types best suited for the purpose for which they were intended, and standardizing them, it was possible to progress with astonishing rapidity toward the solution of the transportation problem. Ships were built of wood, of steel, and even of reinforced concrete, and the principle of standardization was applied as closely as possible to all of them.

The diagram above represents the longitudinal section of a typical steel cargo vessel of modern construction. Steel ships of this type are about 415 feet long from stem to stern. Their width, or beam, is 55 feet, and their height varies betweeen 35 feet from the keel-line to the planks of the upper deck, and 64 feet from the keel-line to the top of the chart and wheel-room surmounting the bridge-deck. The planks of the bridge-deck are about 40 feet above the keel, those of the poop-deck astern about 45 feet, and those of the forecastle-deck, crowning the bow of the vessel, about 50 feet. When the vessel is loaded, the keel is about 24 feet below the surface.

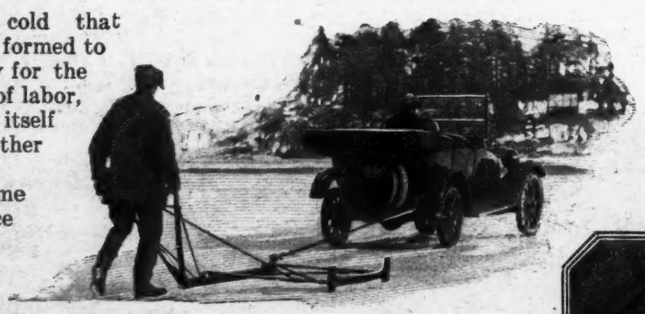
The keel forms what may be called the backbone of the ship. To it are attached the frames or ribs of the vessel, and upon it rest the pillars or posts that form the support of the decks and superstructures. Between

Use Your Car for Ice-Cutting this Winter

LAST winter was so cold that enough ice must have formed to provide a generous supply for the dog-days. But shortage of labor, that old war-cry, applied itself to ice-cutting as well as to other industries.

Here is an excellent scheme to make up for the absence of ice-cutters. It is worth trying out if you have an automobile, a cutting-machine, some ice, a place to keep it in when cut, and a friend to help you do it. Simply attach the cutting-machine to the automobile, and let the car pull the cutter across the ice.

Lest the car skid on the slippery ice, the two back tires should be removed and iron rims with spikes on them substituted. As an extra precaution, put chains on your front wheels.

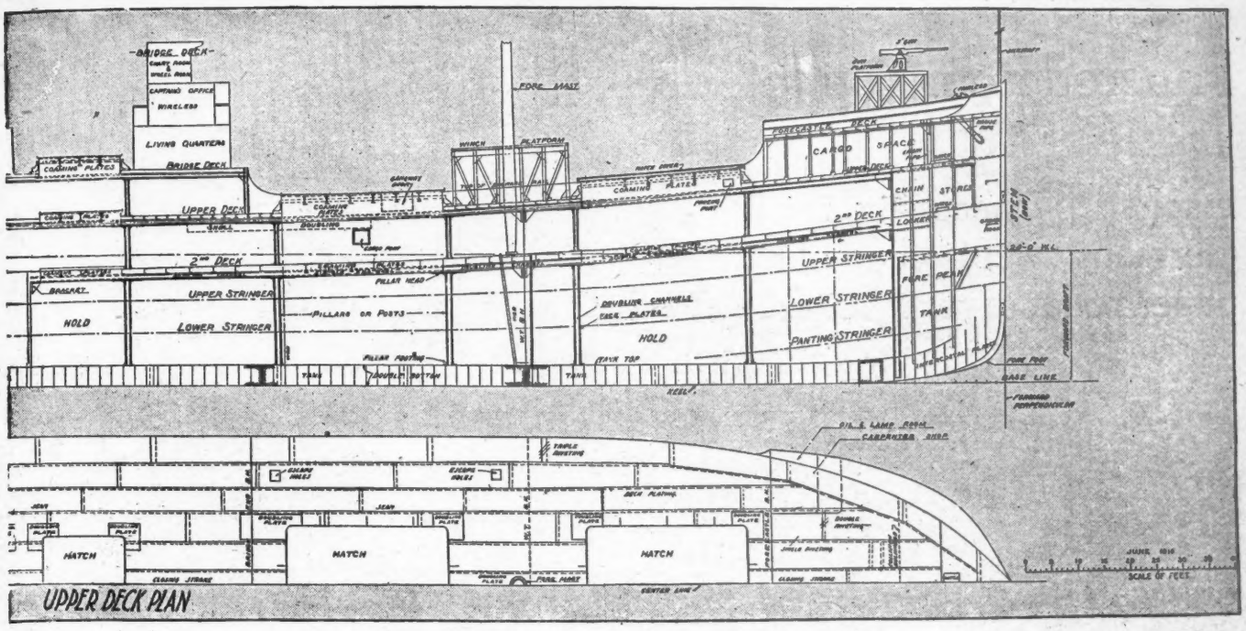


With an automobile pulling the cutting-machine, two men only are needed to cut the ice

One man runs the automobile and the other guides the machine. If your friend is good-natured, let him trot behind with the cutter handle in his hand. If he is not, do it yourself and let him run the car.

Provided one has the facilities, it is quite possible for two men, one automobile, and a cutting-machine to do the work of many ice-cutters.

The rubber tire is taken off, and an iron rim trimmed with spikes takes its place



Why Our Troops Reached France in Time

the keel and the hold the ballast-tanks extend through the entire length and width of the ship. The engine-room occupies a comparatively large space amidship, and has an air and light shaft extending to the top of the bridge-deck and covered with a sky-light.

The boiler-room also has a shaft to the bridge deck, and the furnace flues go through the second, upper, and bridge-decks to the smokestack or funnel. From the engine-room the propeller-shaft runs aft to the propeller, which is placed between the rudder and the stern plates of the vessel. In its entire length it is enclosed in a tunnel, and at intervals it rests upon supports, called plummer-blocks, which hold the heavy shaft in line.

Above the hold of the vessel is the second deck, which, like the hold, is intended for the storage of cargo. The lower coal-bunkers are in compartments above the engine-room and the boiler-room, surrounding the air-shafts.

In the bow section of the second deck are the store-rooms and chain lockers. The upper deck has the crew's quarters aft and cargo space at the bow, surmounted by the platforms for the forward and aft guns. Winch platforms surround the fore-mast and the main-mast, with their boom derricks for hoisting or lowering cargo through the big hatches.

The life-boats are placed aft of the bridge-deck, which occupies the greater part of the space between the two masts. Underneath the bridge-deck are loading spaces and the upper coal-bunkers, and the bridge-deck contains the living quarters of the officers, the galley, directly aft of the boiler-hatch and funnel, the captain's office, the wireless-room, the chart-room, and the wheel-house.

A Home-Made Steam Bath for Frozen Feet

With this home-made steam bath anybody can fight frost-bite

THE beneficial influence of local steam baths on frozen hands or feet was recognized early in the world war by Dr. Salignat, a French physician, who used the treatment with remarkable success in the field hospital with which he was connected. Dr. Salignat was killed by a shell in 1916; but the treatment originated by him has been continued with great success.

The apparatus is extremely simple, so that it can easily be improvised in any field hospital. It consists of a blue-flame kerosene stove, a boiler made of a pan with a conical cover ending at its apex in a tube, and a steam-box of simple construction. It has a hinged cover, and openings through which the hands or feet are inserted into the box for treatment.

The steam enters through an opening near the top, and escapes through small openings in the curved tube, which is connected at its upper end with the tube from the steam-generator and ends just below the floor of the box. The lower opening is closed with a cork, which is removed when it becomes necessary to allow the water of condensation to run out.

Wooden strips are fastened on both sides of the perforated steam-tube to prevent the hands or feet of the patient from coming in contact with the hot metal. Each treatment lasts from ten minutes to fifteen minutes. At first one treatment a day is given; later one in two or three days.

Papered from Top to Toe

Inspired by necessity, the Germans went the old paper collar several better

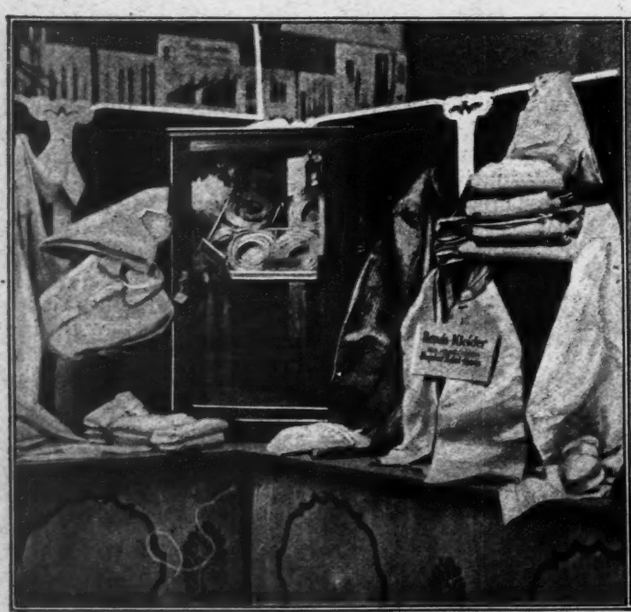
From the skin out and the boots up, Fritz goes clad in paper. These Berlin sandwich-men are advertising wood and paper shoes. "Durable and water-proof," say the signs

Photographs © International Film

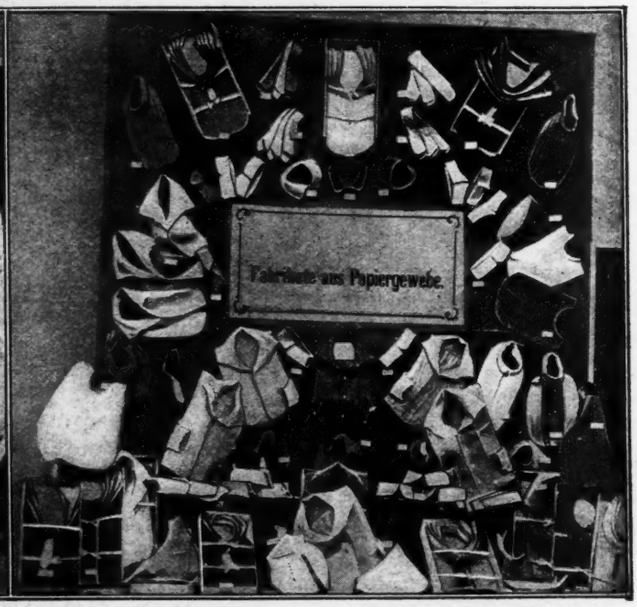
This is a thin paper fabric used as lining for the paper clothes: it is said to be both warm and sanitary

Everything in the picture is made of paper, except the horses and the soldier. The fittings of the horse, and even the rope around the exhibit, are paper

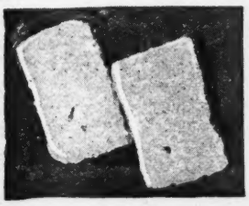
By contrast with the paper cloth across the page, this upholstery "cloth," stamped with characteristic designs, is durable



A corner in the men's suits division at a paper goods exhibit held at Charlottenburg; don't they look like regular clothes?



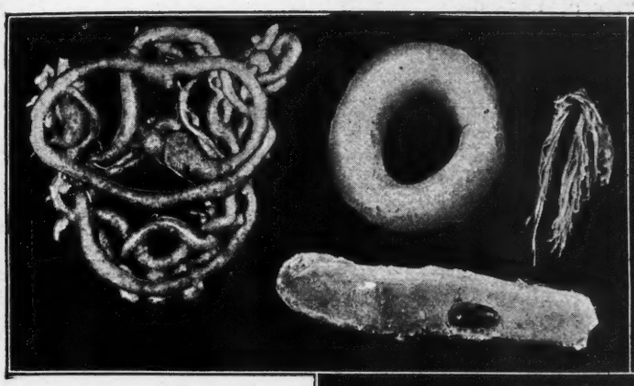
Paper collars have long been the sport of low comedy. Here they appear in sober earnest, supported by paper shirts

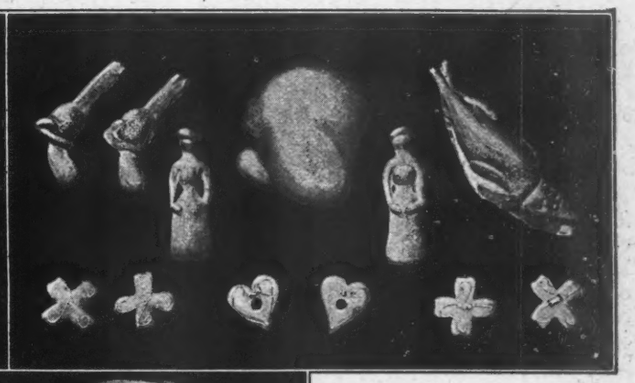


Give Us This Day Our Daily Bread

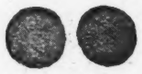
Some strange answers to a universal human demand

The Japanese knight riding across the foot-square rice cake beloved of his countrymen apparently has designs on the national flower tea biscuit and snow-white sea-weed crackers ($16 a pound) on the left

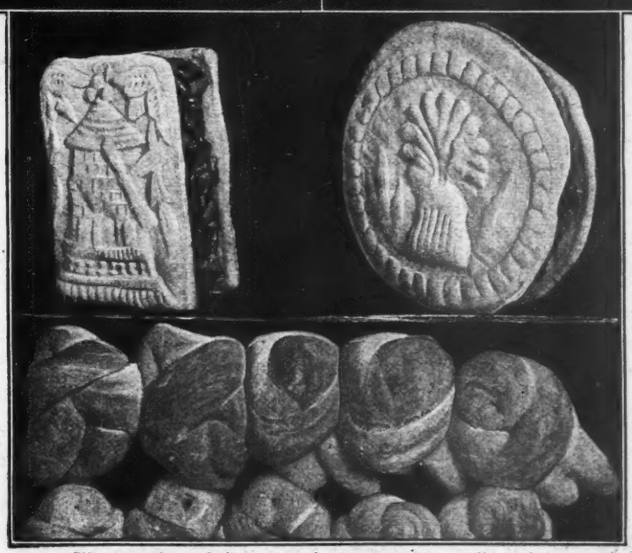




Lusciously sweet and fantastically shaped biscuits and butter cakes baked for the harem of the once terrible Turk; and a fragment of Asiatic "shredded wheat" before molding and baking it into bread



In the package are almond-flour biscuits prized by the Chinese. Below it the dazzling-white rice cakes—most immaculate of "crackers"



These turbaned, long-nosed creatures are really only a "break-off" of freshly baked Italian army hard-tack; the works of art above, Armenian unleavened bread

The boxing-glove (upper center) is really a Scotch haggis, of oatmeal and chopped meat. The other exhibits are a few of the made-fresh-every-day "educational" breads and biscuits of the Italians

More almond cakes and rice cakes. The Oriental peach, the edible kernel of which supplies the flour used in these "almond" cakes, is known as *uruk*

Left: Japanese biscuits made of whole seeds, and hard-tack such as Caesar's legions ate; *center:* the sun-baked roly-poly that is sold by the yard in Asiatic bazaars; and (*right*) more samples of Roman bread

Japanese "educational" biscuits and their water-proof paper-veneer container. The forms illustrated—lotus leaves, peanuts, mushroom fungi, and vegetable miniatures—are only a few of the many designs found in Japan

The road has been cut off by a landslide, so they took a chance on the big pipe

An Aqueduct Used as an Emergency Highway

A MEMBER of the Los Angeles Motorcycle Club recently accomplished a feat that fellow members had declared impossible. John E. Hogg drove his motorcycle, with its side-car, over the Boquet Canyon Siphon of the Los Angeles Aqueduct. The ride over the big pipe had been made "solo," but the three-wheeled construction of the side-car and motorcycle combination made the feat more difficult.

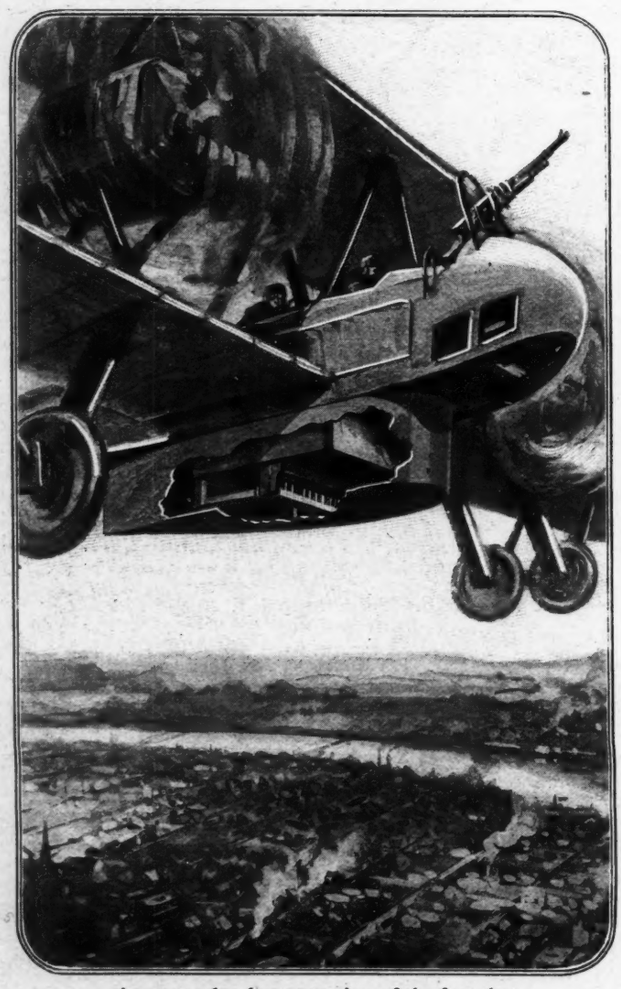
The ride was not taken in a spirit of bravado. With his wife, Mr. Hogg was returning to Los Angeles from the Mojave Desert by the Soledad Canyon Route. After traveling nineteen miles down the canyon, the route was found to be blocked by a landslide. It was ninety miles back into the desert and the Los Angeles Valley again, and to go back by any other route would mean the loss of many hours. Accordingly he drove back up Soledad Canyon to the point where the Boquet Canyon Siphon comes over the mountains, ran the vehicle out on the pipe, and began the four-mile journey uphill and down over the sloping steel surface to Boquet Canyon.

To avoid taking unnecessary risks, Mrs. Hogg walked up and down several of the steepest pitches in the pipe. Stops were made by gradually driving the motorcycle wheels down the slope of the steel until the side-car was well over the top of the pipe, then lowering the side-car wheel until the tire rested on the steel surface.

Hark—There's Music in the Air

THE most remarkable job in piano-moving that has been recorded was put through when one of the big bombing-planes used by the Allies flew from London to Paris freighted with a full-sized instrument of the upright type. The airplane was not competing with union piano-movers, nor was there a sudden shortage of musical instruments in the French capital. The flight was made to bring home to the dullest understanding the carrying capacity of a modern airplane.

Big bombing-planes, such as the Handley-Page which carried this piano, carry crews of from three to five in addition to a considerable load of bombs, and the Handley-Page has a record of carrying on a "stunt" flight twenty-one passengers—more than three thousand pounds. Perhaps the greatest weight-carriers now are the Zeppelin airplanes, capable of carrying two bombs each weighing a ton, besides gasoline and a crew of four.



A spectacular demonstration of the fact that the Handley-Page is a real weight-carrier

How to use your bicycle in the winter, when roads are blocked with snow and ice

Pedaling Makes the Wheels Go Round

A BICYCLE, some ropes, some wheels and tools—and an ingenious Frenchman had all the equipment he needed in order to make a living as a machinist. He mounted the bicycle on stands to keep it from starting forth when he began to pedal.

On the axis of the rear wheel he attached a large wheel, grooved to receive a band. On the front wheel he mounted two similar but smaller wheels, and on a stand fastened above the handle-bars he placed a fourth wheel. He slipped a band around the back wheel and one of the front ones, pulley fashion. He did the same thing to the other front wheel and to the wheel on the stand. Then, on the axis around which this stand wheel revolves, he mounted an emery-wheel and a small tooth-edged saw.

Now, when he sits on his bicycle and starts to pedal, the gears revolve the axis of the rear wheel, which of course turns the attached wheel. The pulley arrangement starts the front wheel, and consequently the front axis, revolving. This sets the second pulley in motion and the tools begin to turn.

The illustration shows M. Caillé, the inventor, cutting a piece of wood on the tooth-edged saw. Perhaps when he finishes he will sharpen a tool on the emery-wheel. His work is not confined to sawing and sharpening, for he can easily detach one of these tools and put on some other one.

Models that Save Money for the Builder

IT is one thing to plan and design a structure, and quite another thing to erect it in accordance with the designs of the architect. If the design is conventional in form, size, and material, the task of the builder is comparatively easy; but it becomes extremely difficult when the plans involve the use of untried materials, new forms, and unusual dimensions.

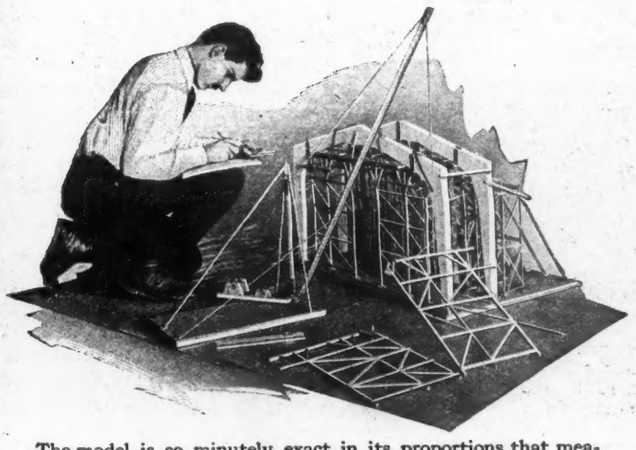
In such cases the work of building is, to a very great extent, experimental. Difficulties, undreamed of by both the architect and the builder, may develop in the course of construction, and upset all calculations concerning the probable cost of construction.

A Western builder, who had undertaken the erection of several large buildings unusual in design as well as in the materials to be used in their construction, realizing the necessity of exceptional precaution, decided upon the construction of a model on a reduced scale of the proposed structure as the first step in carrying out his contract.

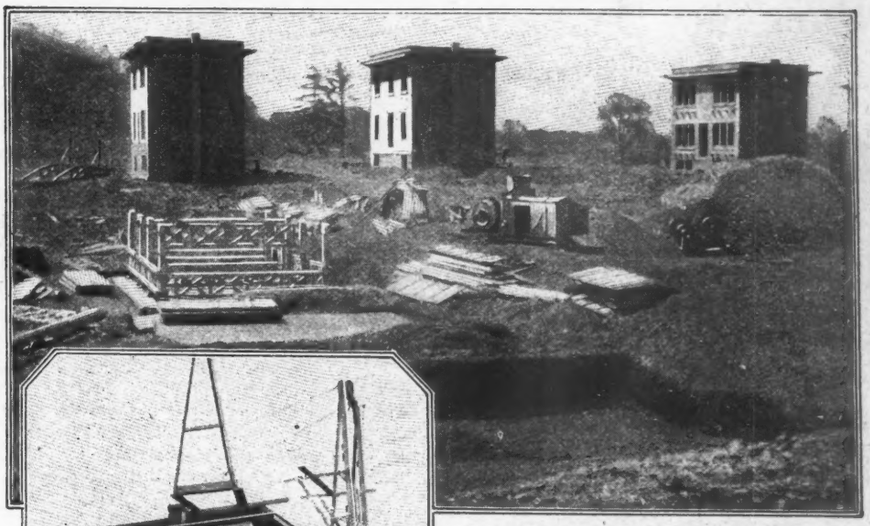
The model, which required thirty hours' work by a skilful carpenter, reproduced not only the forms to be used, but also the scaffolding and bracing, and made it possible to study beforehand the best methods of putting together, setting up, moving and dismantling the framework necessary in the work of construction.

The builder found the preliminary study of the model a great help in the actual work of construction, and completed his contract without a hitch. For example, he discovered, by experimenting with it, that if he eliminated all the diagonal sway bracing on one side of the arch scaffold the column forms would go into place more readily.

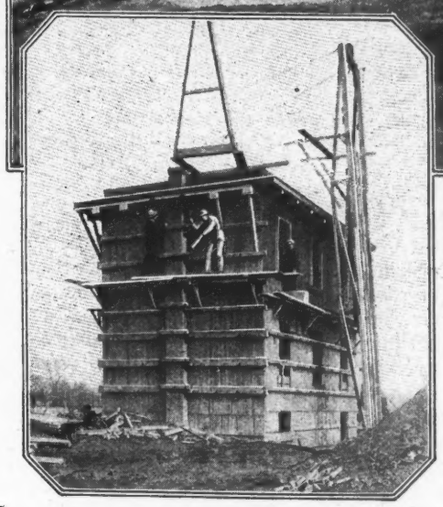
According to his calculation, the use of the model saved him probably ten per cent of the contract price



The model is so minutely exact in its proportions that measurements for a large building can be taken from it directly



Building a group of Ingersoll concrete houses, shown in various stages of completion. The hole in the foreground is almost ready for the foundation. Beyond it the basement floor is "poured for the house on the next lot, and still farther in the rear, posts and framework for the lower part of a house are in place



This house has been "poured," and the men have begun to take down the forms, to have them all ready for the next house to be "poured"

A Comfortable House for $1,000

WHEN concrete came into general use for building purposes about twenty-five years ago, some speculative minds thought they saw the solution of the housing problem.

In manufacturing centers it is always difficult to keep pace with the rapidly increasing population by providing adequate housing facilities for the workers and their families. In some of the older manufacturing towns you may still find long rows of small dilapidated frame cottages, and equally long rows of ugly, squalid, and unhygienic tenements.

Modern civilization, however, is demanding for its vast army of workers, better, more hygienic conditions than those offered by miserable wooden shanties and disease-breeding tenements.

Why not build houses of concrete? The material is cheap and obtainable in abundance. Several inventors, among them Thomas A. Edison, devised means for making houses of concrete by casting them in one piece. A number of such monolithic concrete houses were built, but the great cost of the casting forms made the houses too expensive for persons of moderate means.

Robert H. Ingersoll, the watch manufacturer, worked out a plan to overcome this difficulty. He selected a type of a four-room house with basement, bath-room, and kitchen as the most suitable, and had the forms for casting it made in such a way that they could be used again and again. Even at the present high cost of labor, these houses can be built for $1,000 each.

After the ground has been carefully leveled, side rails are staked on the bottom and footings, and the entire floor is then poured in one piece. Next, vertical corner posts extending to the height of one story are set up on wedge blocks, and are held true to the plumb by trusses and bridging. On this frame are hung the forms that mold the concrete of the outside and inside walls, the floors and roof construction, the cornice, etc. The ventilating and plumbing pipes, electric conduits, the window-frames, etc., are all set in place before the concrete is poured. Water supply pipes are exposed in accordance with modern plumbing methods. A complete house of the four-room type described requires about 1,000 pounds of steel and 75 cubic yards of concrete.

Completing eight hundred miles of pipe-line by putting in place the last connecting piece

The pipe-line across the Kankakee river was first laid on the ice and then sunk

Photographs © Kadel & Herbert

The Longest Pipe-Line in the World

THE oil-fields of Oklahoma and Kansas have been connected with the distributing terminus at East Chicago by a pipe-line which enjoys the distinction of being by far the longest ever built. It is about 800 miles long and one foot in diameter. The engineering difficulties that had to be overcome in the building of this pipe-line were great, notwithstanding the favorable fact that practically the entire line could be laid on flat prairie-land. There were no mountain-ranges to cross, the principal obstacles being numerous rivers and smaller water-courses.

The laying of the pipe-line, which had become necessary because of the difficulty of transporting oil in tank cars on the congested railroads, was done during the winter. One of the pictures illustrates the method used in constructing the pipe-line across the Kankakee river, which at the point shown is about one thousand feet wide. The line was laid in a curve with the apex pointing upstream, on the ice which covered the river. Then the ice around the pipe was cut away and the pipe was allowed to sink to the bottom of the river. The swiftness of the current and the formation of the river-bed had been carefully ascertained to make sure that the pipe would come to rest upon the bottom of the river in a straight line.

The work of laying the pipe-line was begun at several points at the same time, and the pipe-laying gangs worked from one section toward the next section until the pipe sections met and were connected.

Getting the Best of the Coal Man

AN extremely simple portable oil heater, built on the unit plan, has recently been placed on the market.

The heater weighs from eleven to sixteen pounds. A sheet-iron case resting on four legs, and having a handle at the top for convenience in carrying, holds the heating device. An oil reservoir, which may be pulled out like a drawer, is at the bottom. It has two or three burners provided with glass chimneys and a reflector of burnished copper behind them. According to the amount of heat desired, one, two, or all three of the lamps are lit.

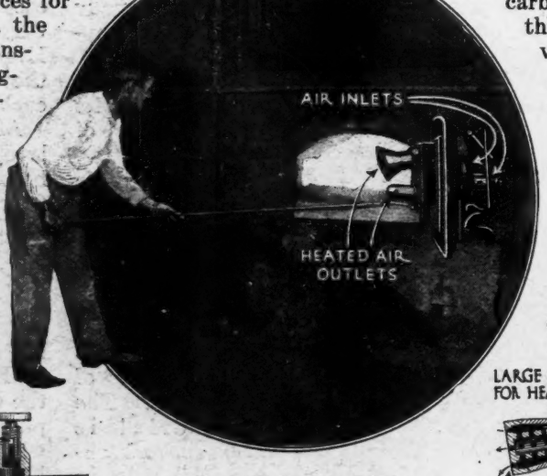
A simple oil heater like this will enable you to conserve coal and to score one on the coal man

Feed Your Furnace with Hot Air and It Will Stop Smoking

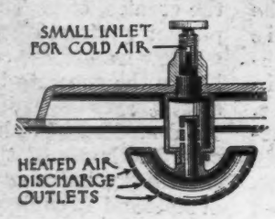
WITH the fuel that has been wasted since furnaces came into use we could, in all probability, heat all existing furnaces for a hundred years. Unfortunately, the wastefulness of our methods of transforming fuel into heat was not recognized until recently, and comparatively little has been done.

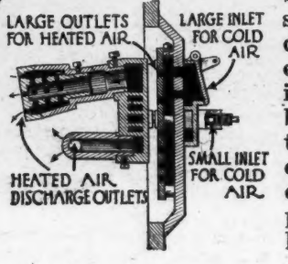
The cause of the wastefulness that finds its outward expression in black smoke issuing from the smokestacks of our factories and heating plants is imperfect combustion. The heat-producing element in our coal, as well as in most other fuels, is the carbon contained therein. When carbon is heated to a high temperature in the presence of air, a chemical reaction takes place, accompanied by the liberation of a large amount of heat. The carbon combines with the oxygen of the air, forming various stages of oxidation of carbon. Leonidas W. West, an authority on smoke prevention, has invented several forms of a device for aiding this combustion by the injection of highly heated air, which, mingling with the hot gases, forms a combustible mixture which consumes the smoke.

The device illustrated is an attachment for the door of the fire-box. The door has a draft-opening, the cover of which is automatically raised when the door opens. The air passes into a chamber on the inside of the door, is heated, and passes into the fire-box. When the damper is closed another device supplies the heated air.



When the fireman raises the furnace-door latch, he is reminded by the automatic raising of the damper that air is needed to prevent smoke





What Will the Breweries Do?

Science and economics have united to find new uses for plants worth millions

By H. E. Howe

[When this article is read, every brewer in the United States will have shut up shop or be at work adapting his plant to changed conditions. That means that machinery costing millions will have to go to the scrap-heap unless ingenuity, guided by the expert advice of the industrial chemist, can find a way out. The amount of capital involved is very great, and difficult to estimate accurately, but these figures are significant:

Ten years ago a single concern was offered $10,000,000 for its plant and good will, while an English syndicate is said to have $160,000,000 invested in American breweries.

H. E. Howe, who analyzes the problem for POPULAR SCIENCE MONTHLY, *is a chemical engineer connected with a large firm of industrial chemists.*

THE EDITOR.]

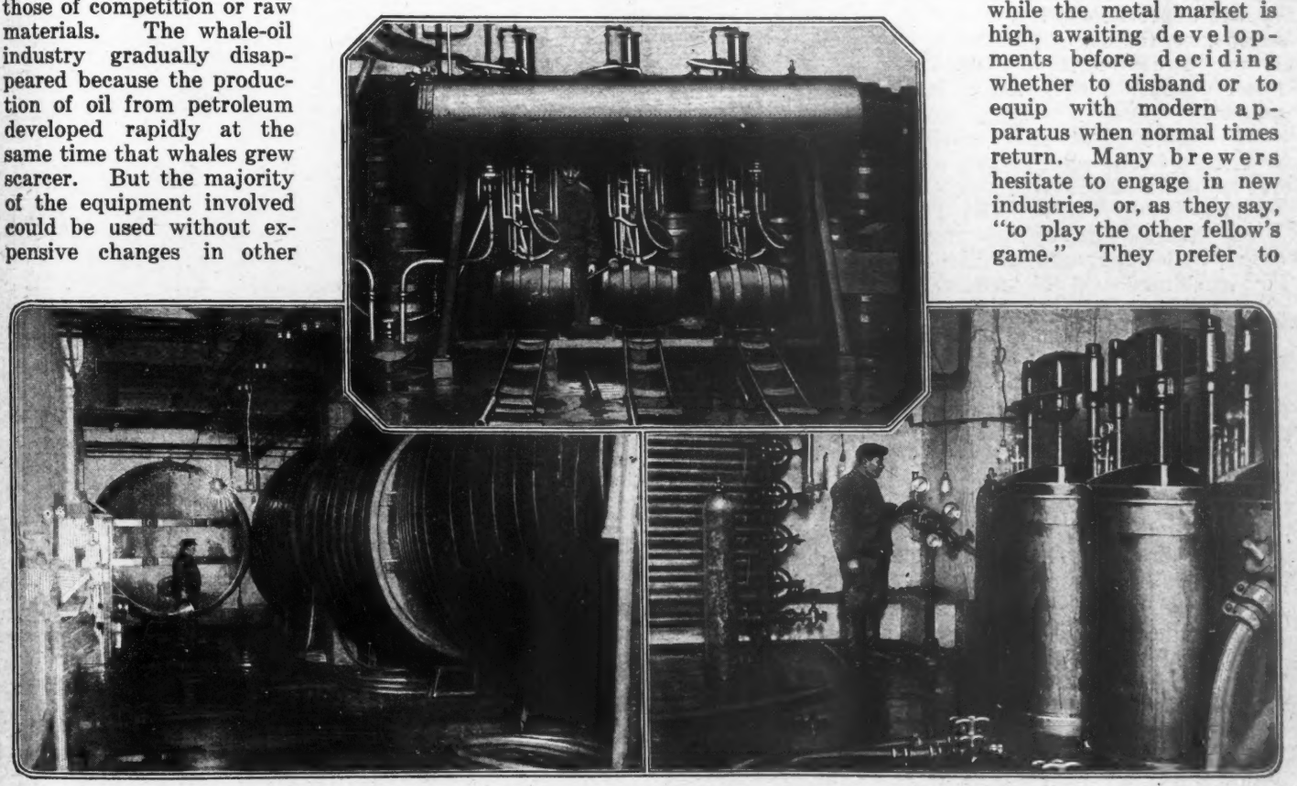
IN the past, when industries have been compelled to cease operations, the reasons have been those of competition or raw materials. The whale-oil industry gradually disappeared because the production of oil from petroleum developed rapidly at the same time that whales grew scarcer. But the majority of the equipment involved could be used without expensive changes in other directions. It was a comparatively simple matter for those engaged in hunting whales to turn to any of a number of seafaring occupations.

When the chemist, after more than five years of research and the expenditure of millions, succeeded in producing synthetic or artificial indigo in commercial quantities, many square miles of indigo plantations in the far East had to turn to other agricultural pursuits. The change came quickly, but here again both facilities and labor could be profitably employed in other directions.

Unique Case of the Brewers

The brewing industry, however, is a unique case. It involves a special industry, and, notwithstanding repeated warnings to prepare for changed conditions, there has been, with but few exceptions, no constructive work done to enable the invested capital to continue earning dividends. The amount of this capital is, of course, very large indeed. Accurate estimates are difficult to make, but ten years ago one concern was said to have been offered $10,000,000 for its plant and good will, and an English syndicate is understood to have $160,000,000 invested in American breweries.

Several view-points are held and various policies followed by the brewers regarding the future. Some breweries have already made radical changes; others are preparing to quit business of any kind, and their owners will retire; several believe post-war legislation will permit them to brew 2 per cent beer, and so will keep their property in condition at considerable expense; and a few think it wise to scrap old equipment while the metal market is high, awaiting developments before deciding whether to disband or to equip with modern apparatus when normal times return. Many brewers hesitate to engage in new industries, or, as they say, "to play the other fellow's game." They prefer to



Every brewery cellar had a hundred or more of these resting tanks. They are practically useless for any other purpose

Above: The pneumatic barrel-filling tank is one of the few parts of a brewery's equipment that may be used without change

Each one of these compressors represents $6,000 or more. They may be used for charging non-alcoholic beverages

retire on their accumulated savings, but are anxious to put their plants into a new enterprise, although they hesitate to invest capital in addition.

The breweries that are to turn their plants to new uses present a real problem, which for discussion may be divided into three phases: plants to be used with as little change as possible to conserve expense, and to leave things so that brewing may be taken up again if desirable; plants to be entirely changed; and breweries that are to be considered aside from the property—business organizations with capital and experience, prepared to work in an entirely new field, making the start at the beginning, if need be.

A Problem in Economics

It has been difficult at times to make those concerned appreciate that virtually every brewery presents a different problem, so far as its use in new fields of endeavor is concerned. There may be a class of work that most naturally fits in with brewery equipment, but raw materials, market, competition, location, and other such factors must be considered. The problem often involves more of economics than of science.

The modern brewery is especially designed for a particular set of operations. This is not well suited, of course, to other uses. Breweries require height out of proportion to floor area from the view-point of other industries. The foundations will seldom carry additional weight on the upper floors; for, with few exceptions, the heavy portions of a brewery's equipment are on the lower floors, if not indeed on the ground.

The power plant will probably require important additions for any new work, although this may be confined to the boiler-room. The refrigeration equipment may prove useful, while the bottling and labeling machinery will often remain unused.

A brewery is fortunate indeed if more than a portion of its building and mechanical equipment can be put to work on unfamiliar products, or if more than a limited amount of new apparatus is required. The ideal would be a profitable product to be made with little change in plant, by methods differing as little as possible from those already in vogue. This is seldom approached.

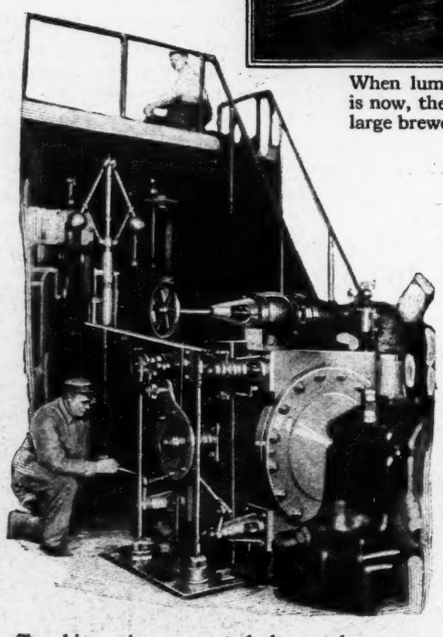
Some Suggestions

So much for the cold facts which must be faced by the brewer whose established brands and trade-marks will be of no material help in his new venture. But let us consider what has been done as an indication of what it is possible to do, and make a few timely suggestions.

Malt is very familiar to brewers, and malt products suggest themselves at once. These include malted milk, malt syrup, maltose, and malt flour.

A Colorado brewery undertook the production of malted milk before legislation was passed making such a move desirable. True, dairy machinery had to be installed. This included a vacuum-pan for concentrating raw milk, and drying apparatus for finishing the product. The malted milk made has earned many friends, and it is understood that the enterprise is already a success.

When lumber was a great deal cheaper than it is now, these storage-casks cost $5,000 apiece. A large brewery had a hundred or more in its cellar



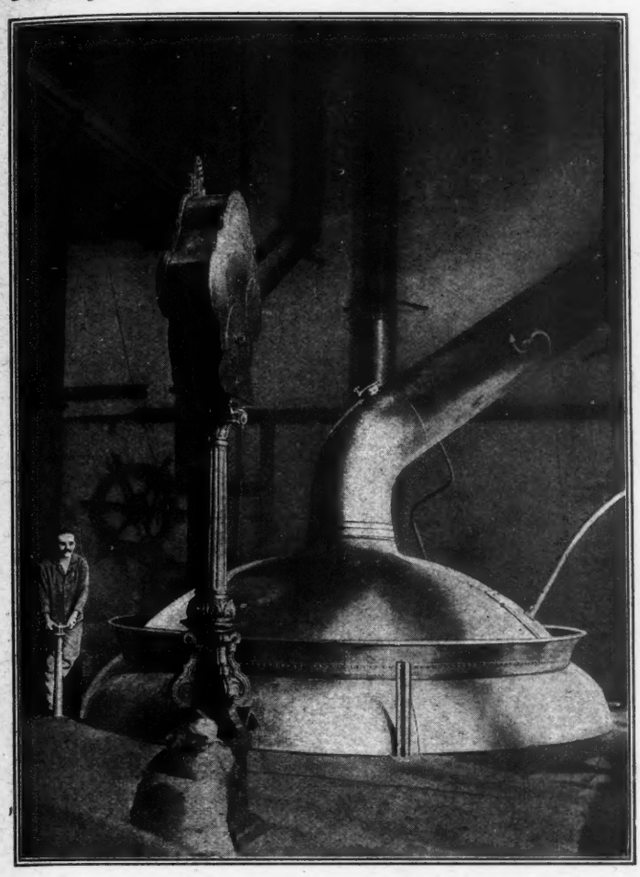
Two big engines, operated alternately to run the refrigerating plant, must be rebuilt if they are to be used for any other purpose

In addition, a portion of the original capital was put to work to make porcelain, with the result that chemists no longer depend upon Europe for satisfactory chemical and technical porcelain. This work was original, required intricate technique to be mastered, and the product had to measure up to the standard already set by satisfactory German porcelain. The undertaking is an entire success, and gives us one of the best examples of what may be done even in unfamiliar lines, regardless of highly organized competition.

Several Brewers Making Malt Syrup

Malt syrup is being made by six or eight concerns formerly in the brewing and malting industry, and thus far the demand exceeds the supply. One producer makes 12,000,000 pounds a year, and is sold to capacity four months ahead. Success in manufacturing malt syrup and maltose, which is malt sugar, depends on the purity of the carbohydrate raw material, as well as care and control in filtering, clarifying, and concentrating operations. Much fine malt syrup is made from barley; corn-starch is the starting-point in other plants.

To manufacture malt syrup, the brewer must master filtering with presses, the use of carbon as an absorbent for coloring agents, and the operation of multiple-effect evaporators at proper temperatures and at high efficiency. The product competes with corn syrup and table syrup made from cane. It is considered one third sweeter than corn syrup, and has an advantage of not requiring the addition of cane syrup to make a high-grade



Of these enormous copper brewing-kettles every large brewery had two or more. They cost from $20,000 to $25,000 apiece, and now, of course, become copper junk

product. It can be made of good color, has a distinctly pleasing taste, and is a valuable supplement to our sugar supply.

It makes superior hard candy, is used in crackers, bread, etc., and enters into many foods. As an article for export it finds a ready market in England for the production of beer, etc.

A New Cereal

Malt flour is thus far little known in the cereal market. As the name indicates, it is made by grinding malt between rolls and sieving the flour to remove any husks. Being very hydroscopic, malt flour presents some minor difficulties in package selection for storage and transport, so that it may be found better to extract it with cold water, and after filtering concentrate the solution to a paste.

According to C. A. Nowak, these malt products impart valuable characteristics to bread, especially those made from strong, harsh flours. The flavor is improved, and the bread dries out much more slowly and is more easily digested. The malt also feeds the yeast, and so shortens the time required for fermentation. No doubt some educational work will have to be carried on to encourage a wider use of such malt products, but this is the case with every new material.

Yeasts are really little known, and yet they undoubtedly offer an attractive field for the brewer. There should be profit in growing special yeasts under exact conditions as a source of an extract for human food. Yeasts are known to contain proteid and fat, and a properly prepared extract should rival beef extract. Some research is required to find the right method, but the reward is large. Then, yeasts offer an excellent raw material for special stock foods. Combined with some cheap carbohydrate such as low-grade molasses and a crude fiber absorbent, which might be pith, peat, or sugar-beet pulp, well balanced rations to suit specifications should be possible. There is also an opportunity to market compressed yeast.

In dairy districts the brewery may become a factory for milk products, which are varied as well as numerous.

Every brewery had one or more of these costly filter-presses, used for pressing the liquid out of the yeast; they cannot be used for other purposes without material changes

They include lactose, casein, butter, and cream. There is always an opportunity for a distinctly flavored cheese, while many believe this war will establish dry milk in our list of foods, just as the Civil War intrenched condensed milk. Specially fermented milk beverages improving on buttermilk should also be considered.

World's Scarcity of Fat

Another food product is vegetable oil. We seldom have an excess of fat in the world, so that the perfection of hydrogenation of oils has been a basic advance. By this treatment of oil with the gaseous element, hydrogen, in the presence of a catalyzer, (which promotes the reaction without entering into it), the oil is so changed that it resembles hard fats in all essentials. Unpleasant oils like fish oils are so changed as to make them useful in such industries as soap-making, while such high-grade oils as peanut, cocoanut, and cottonseed enter the lard and butter class. The refining of oils is another kindred industry.

The advantages of dry milk have been mentioned. Dehydrated fruits and vegetables are nearly as important, and offer possibilities to many a brewery and malt house having kiln equipment. We are just learning the economic advantages of properly dehydrated fruits and vegetables. There are hundreds of dehydrating plants in Europe, especially in Germany. One of the largest breweries in the South is about to be converted into such a plant, with which will be combined the manufacture of yeast.

In fruit belts sweet fruit juices may be put up, as loganberry juice is bottled in the far West and clear apple cider in Indiana. The process involves the pasteurizing, bottling, and labeling machinery, the refrigeration plant, storage, and some of the vats.

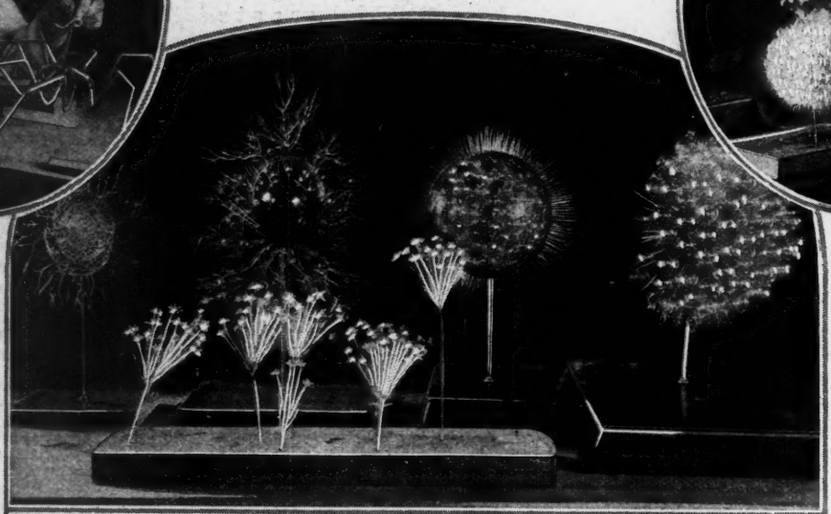
One brewery is reported to have gone into the canning business, putting up clams in addition to the usual fruits and delicacies. Soft drinks have appealed to many. The brewery's refrigeration plant forms the nucleus of other industries. Functioning as a cold-storage plant has already been undertaken. The manufacture of ice and the making of ice-cream also concern this portion of the equipment.

At the moment, industrial alcohol seems attractive; but this interests distillers more than brewers, since a modern still is essential. Unless ways can be devised to permit the wider use of alcohol and it can be produced to compete in price with petroleum products as a motor fuel, there would seem to be an over-production, now that the war is over.

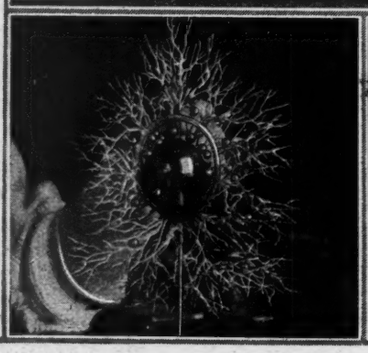
Wonderful Sea Creatures Spun from Glass

Herman Miller, expert glass-blower at the American Museum of Natural History, in New York, at work on a glass model of a sea-spider enlarged to twenty-five times its natural size

His tools are a pair of forceps, a carbon pencil, and a flame; with these and glass tubes he copies nature's work exactly



Unusual specimens of the glass-blower's art, which form a part of the wonderful collection at the Museum. This group represents six months' work

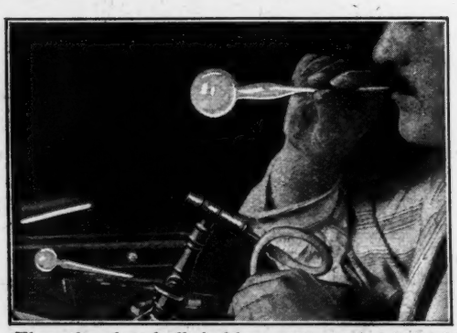


Assembling the parts of a very complicated model of sea life made up of thousands of delicate parts. This piece of work represents the result of six weeks of labor

Glass model of a branch of a marine plant (magnified many times) being held in the gas-flame while the small spines are carefully attached to their places

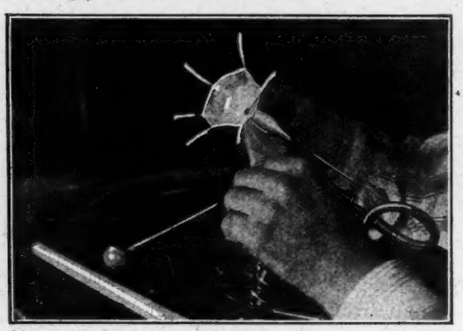
Photographs © Publishers' Photo Service, Inc.

Making a glass flower. First the glass is heated in the center and drawn out to form a bulb at one end



Then the glass bulb is blown out to the desired size, broken open, and shaped by a carbon pencil

The sides of the flower are formed by means of a carbon pencil as the glass is held in the flame

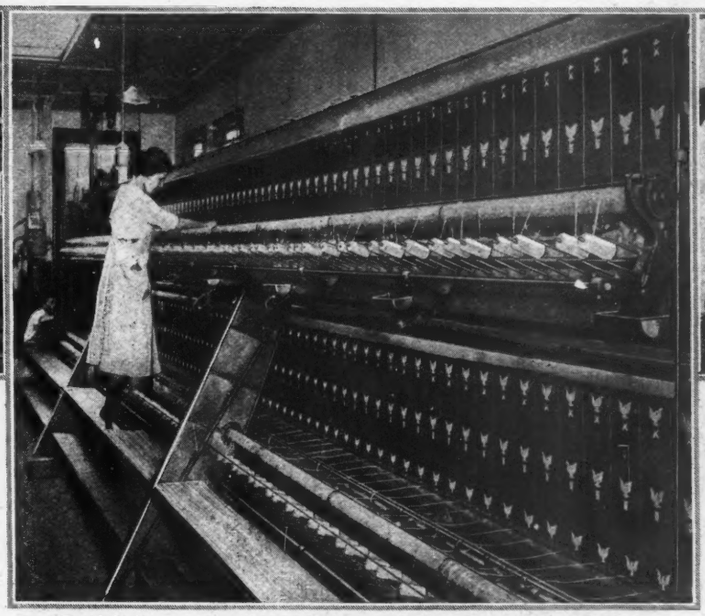


These bits are attached by touching them to the edges of the petals at points heated red-hot

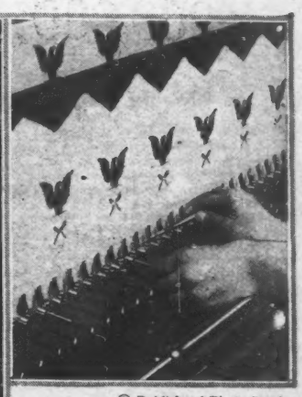
Turning Out Chevrons by the Hundreds

© Publishers' Photo Service

A handful of filled shuttles, ready to take the place of fellow workers which run out while the machine is in action. The shuttles, under the supervision of one girl, feed thread to a machine that embroiders chevrons



Her job is to watch for broken threads on 180 spools; for the machine turns out no fewer than 180 chevrons at one operation



© Publishers' Photo Service

Evidently when a child she never mixed her fingers up with the needle on her mother's sewing-machine, for she earns her living now by fearlessly threading the needles on this big machine while it is running

© Publishers' Photo Service

The long strips of finished chevrons are carefully cut by hand into individual parts

© Publishers' Photo Service

When the ten yards of chevrons, six rows deep, are finished, they are laid out on the table and cut into single strips

© Publishers' Photo Service

The pantograph makes it possible for certain popular shops to sell beautifully embroidered articles at ten cents per

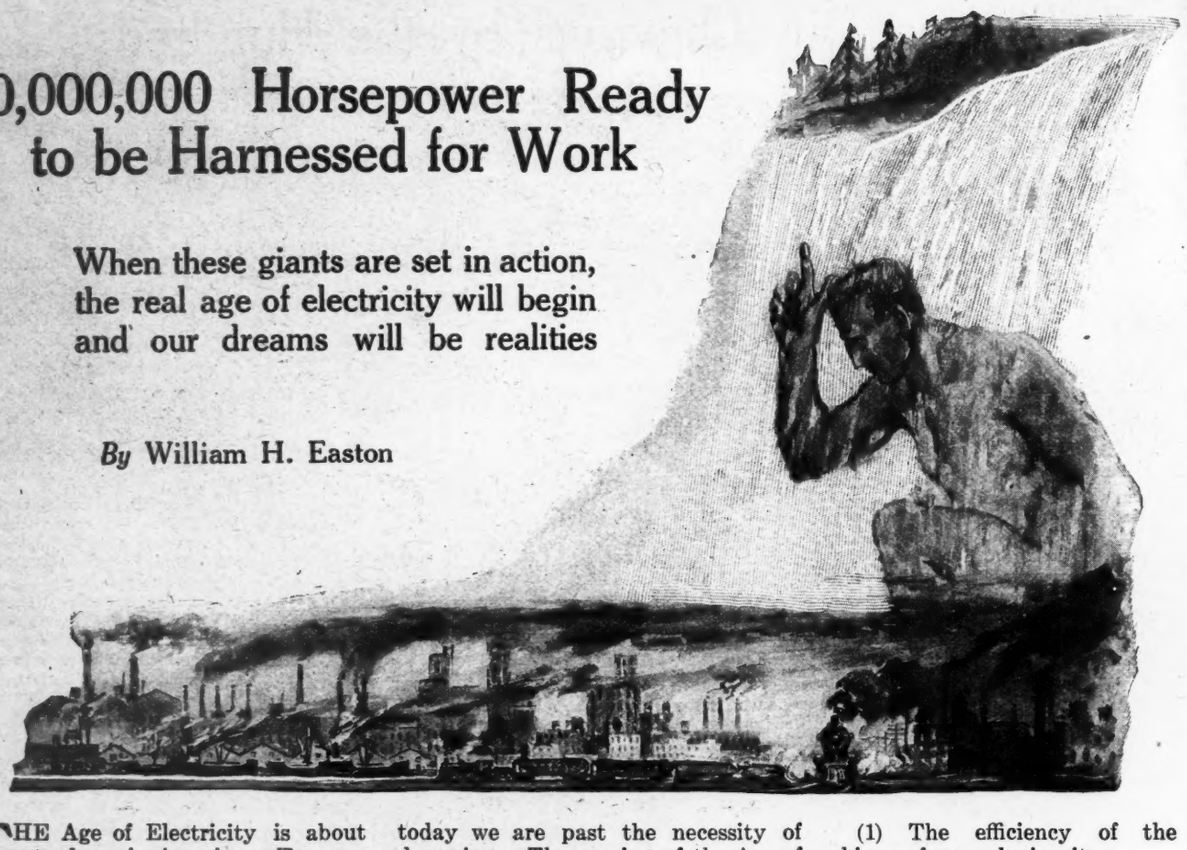
© Publishers' Photo Service

With the pantograph a stitcher traces this enlarged chevron, while all the needles on the machine follow the design

60,000,000 Horsepower Ready to be Harnessed for Work

When these giants are set in action, the real age of electricity will begin and our dreams will be realities

By William H. Easton



THE Age of Electricity is about to dawn in America. To some people, especially dwellers in large cities, this may seem an odd statement. Everywhere are to be found applications of electricity,—telegraphs, telephones, electric lights, trolley cars, factories operated by electricity,—so that the Age of Electricity appears to be already at high noon.

Electricity for Everybody

But appearances are deceptive. In spite of the vast amount of electric energy generated today, we have, thus far, passed through merely the preliminary stages of the electrification of the United States. Only a small portion of our territory is reached by electric power lines, and those of us who are fortunate enough to obtain electricity at all are not able to use it freely for all of the many purposes to which it is suited. Even a millionaire can hardly afford to heat his home electrically—the ideal way.

But a new era is approaching—a time when not only every town, but every farm, mine, and woodsman's camp will be able to obtain electric power, and to use it with almost the same disregard for its cost as the city dweller uses water. This will indeed be the Age of Electricity. Many have unleashed their imaginations and dreamed about this wonderful time, but today we are past the necessity of dreaming. The coming of the Age of Electricity is inevitable.

Though this era would have come in any event, the Great War swept away all obstacles to its advance and brought it much nearer. We know now that the nation's welfare depends upon power and transportation, and that our present methods are inadequate.

It is plain to everyone that the fuel famine of last winter would not have occurred if we had had available an ample supply of electric power, transported from mine and waterfall through cables, thus relieving the railroads from the necessity of hauling the vast amount of coal now needed in every part of the country.

But what reason have we to believe that the supply of electric power will be much greater and its cost less than at present?

The cost of electricity, like that of any manufactured product, depends very largely on:

(1) The efficiency of the machinery for producing it.
(2) The cost of the raw material.
(3) The volume of production.

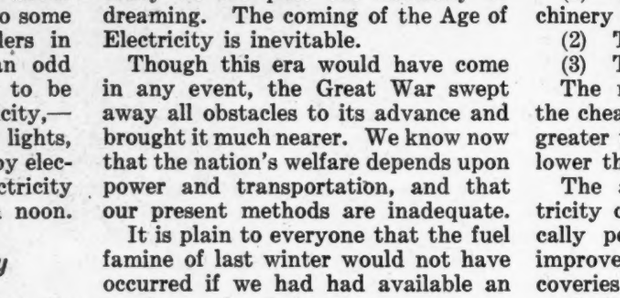
The more efficient the apparatus, the cheaper the raw material, and the greater the volume of production, the lower the cost.

The apparatus for producing electricity can now be considered practically perfected. There is room for improvement, of course, and new discoveries may revolutionize present methods, but machines as they stand are satisfactory. We can generate electricity in any desired amount, transmit it any distance, and utilize it in a thousand different ways.

Unused Raw Material

One of the most important developments is the great increase in the size of steam turbines, which have leaped from 30,000 to 100,000 horsepower in capacity within the last four years, while their efficiency has come close to the theoretical maximum.

The raw material for electricity is power. The power now generally used is steam power, but we also have at our disposal another kind of power. From thirty to sixty million horsepower of waterpower exists in the United States, and of this vast reservoir only about six million is in use. The rest has been closed to development largely by Federal laws, which were de-



The 3½-ton electric truck leading the horse-drawn wagon typifies the present and past in farm power

signed to prevent its monopolization. Congress is now, however, endeavoring to frame laws that will permit the proper utilization of this vast power supply; and this important step toward cheaper electricity will unquestionably be taken in the near future.

The third element affecting the cost of electricity is the volume of production. In the early days of the industry, when the production was small, the cost was very high. But, as the demand for current grew, larger and more economical plants were built. Thus the cost was reduced. Reduction in cost gave rise, in turn, to a greater demand, which again caused greater production, with a further reduction in cost. And so the process has been cumulative, until today electricity costs a fraction of what it did twenty-five years ago. At present we can look forward to the probability of using waterpower extensively on one hand, and huge, economical steam units on the other.

Motor-driven ensilage-cutters will be common farm machinery when the age of electricity really gets here

The inevitable result is a reduction in cost even with the present demand. But it so happens that two great industries stand ready and waiting to use electric power just as soon as a marked decrease in cost and increase in production become possible. These are the railroads and the electro-chemical industries. Soon a large proportion of our railway mileage will be electrically driven; and soon nitrogen will be electrically reduced from the air, metals will be electrically refined, and chemicals will be electrically made. Only a little improvement in the supply of electric power is needed to electrify these industries.

The railways and the chemical factories will use more power than is now being generated for every purpose. This extraordinary increase in the demand will obviously have its effect on costs, and prices will fall to a point undreamed of now.

Distribution Is Important

Another factor in reducing the cost of electricity is the method by which it is generated and distributed. Let us suppose that there are five neighboring towns, and that the maximum amount of current demanded by each at any one time in the course of a year is as given in the following table:

TOWN	MAXIMUM H. P. DEMAND
A	5,000
B	10,000
C	15,000
D	20,000
E	25,000

This list totals 75,000 horsepower. If each town is supplied by a separate plant (now generally the case), the combined capacity of the plants must be at least 75,000 horsepower. But if all five plants were joined together into one system, probably 65,000 horsepower would be enough, because the maximum demands of all five towns would not occur at the same instant. Furthermore, only the largest and most economical of our five plants would be operated continuously, the others being held for "peak" and emergency service. Small and uneconomical plants would be scrapped.

Difference in Waterpowers

To give a specific example of the economy of this arrangement, a careful census shows that the Chicago district is operating power plants totaling 1,050,000 horsepower in capacity, but if all power were supplied from a single system, a capacity of only 825,000 horsepower would be required. The saving in fuel effected thereby would amount to 6,000,000 tons of coal a year, while the saving in labor, land, buildings, equipment, and many other items would be equally great.

With waterpower plants the benefits of interconnection are especially marked, because waterpowers vary so much in their characteristics. Some, like Niagara, can be depended upon for a continuous supply of water at all times; others have high and low seasons, and of these some can be readily supplied with storage reservoirs and some can not. When such powers are interconnected, each can be used to the best advantage with minimum waste of water and maximum economy and reliability.

The interconnection of near-by plants, being therefore the most economical and satisfactory policy, is bound to take place rapidly, especially when waterpowers are brought into service. This process has already been begun in the United States, and England has used it successfully for some years.

Part the Railroads Will Play

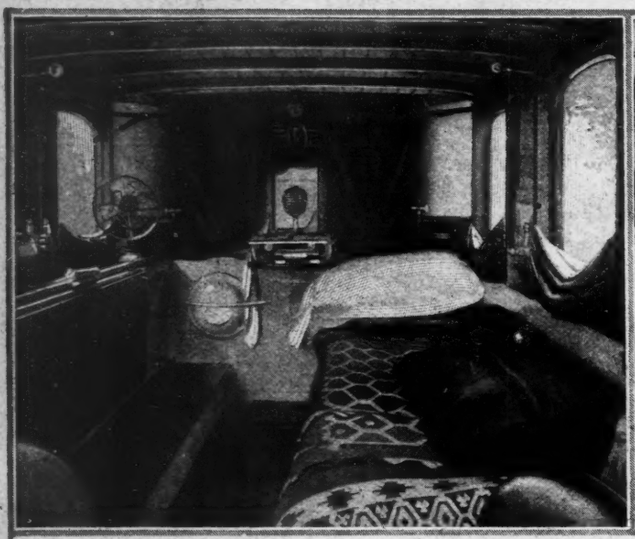
A reduction in cost will take place, but mark this point: Independent plants supply only the area immediately around them, but several plants brought together into one system are interconnected by a network of wire, and these will be so laid out that they will cover effectively the whole of the inhabited territory lying between the plants. With interconnected systems, whole districts will be supplied.

What applies to single plants also applies to small systems. These will in turn be wired together, and the larger systems thus formed will also be interconnected. The process will continue until there is hardly an inhabited part of the country that is not reached by electric power.

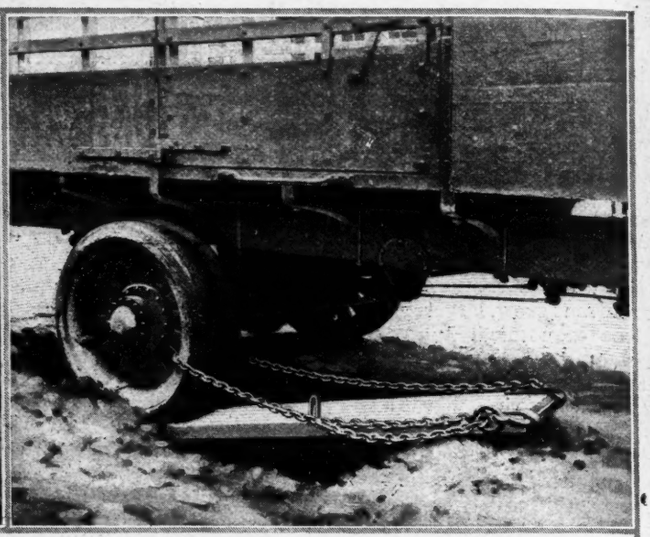
The backbone of the systems will be the railroads, which, being electrified, will carry the main power lines through the densest population, and from these lines branches will run off in every direction.

The raw material for electricity is power, and we have at our disposal from 30,000,000 to 60,000,000 horsepower such as this

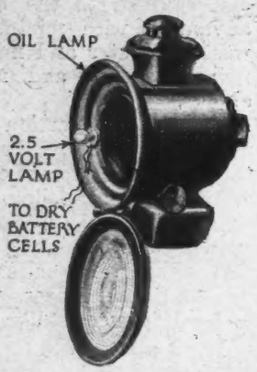
Mechanical Aid and Comfort for



If you wish to travel in comfort, take your hotel with you and board yourself. This is a Texas motorist's idea



Country roads are liable to be full of mud-holes in the spring, and truckmen will find a mud-skid like this useful

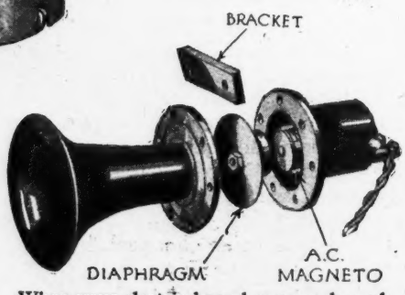


A small bulb, operated by a battery, gives enough light for your side or tail lamps

A small gasoline tractor that will carry two tons or haul a trailer with a 3½-ton load. It is very compact, has a four-cylinder engine of 10-horse-power, and is easily handled

An old headlight rim used to frame the gasoline rate-card

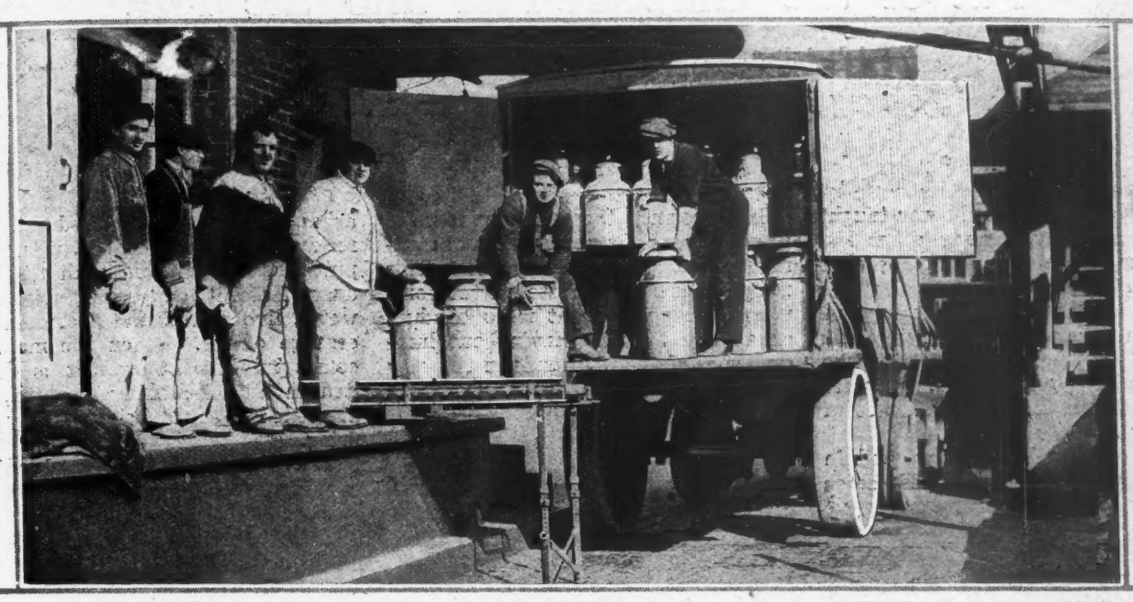
This flexible heater, which uses 200 watts, will thaw out your pipes and keep your engine from freezing



When your electric horn becomes clogged, disconnect it and remove the accumulated dust between the diaphragm and cover

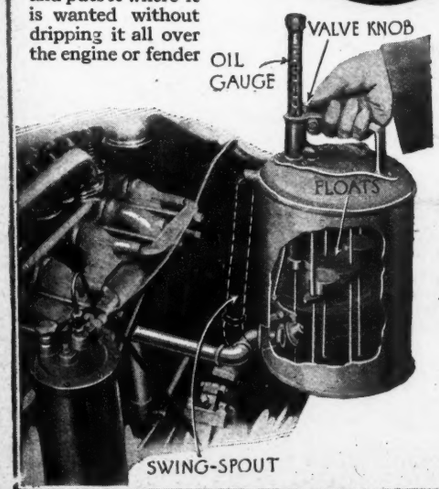
To protect hothouse plants and cut flowers from freezing in transit in winter, a Buffalo, N. Y., florist employed a delivery automobile heated by the exhaust gases from the engine of the car

the Automobile Owner and Driver



Gravity is much cheaper than man-power. Instead of having the cans of milk rolled from the refrigerator to the loading platform by man-power, a large dairy concern allows the cans to slide down a roller-coaster by their own weight

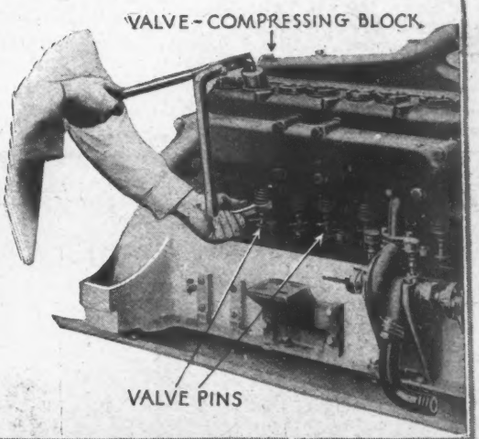
This automobile oiler measures the amount of oil used, and puts it where it is wanted without dripping it all over the engine or fender

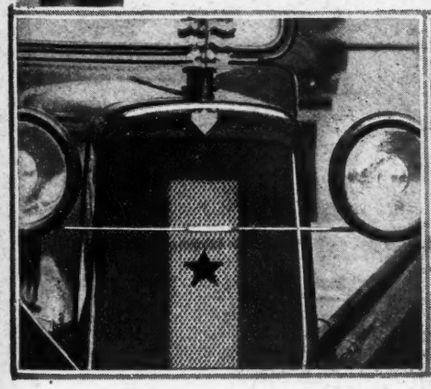


With this vulcanizing cartridge, which supplies its own fuel, mending tubes becomes an easy task

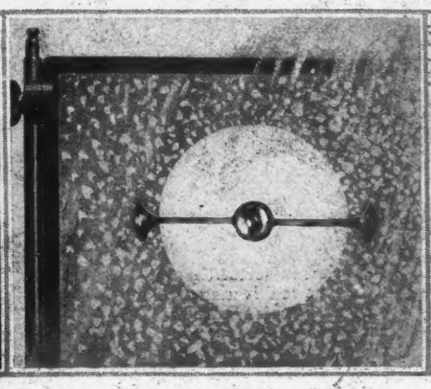
A new battery-gage warns you when your storage-battery needs attention

A new valve-lifter has a U-shaped bar with a pivoted handle and holds the valve down while the spring is compressed to remove the valve pin

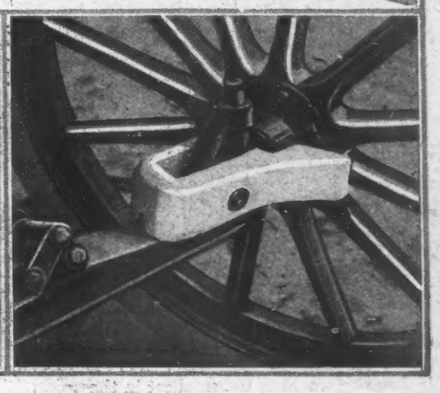




The service flag on this radiator will never rattle. It is painted on



Snow, ice, or water cannot adhere to this motor-driven glass disk



With this locking device your automobile will run in a circle

Out of the Garbage-Pail into the Fire

Fuel bricks are now added to the list of things salvaged by science from the nation's waste

By Joseph Brinker

LONG before the world war taught us economy, among other lessons, there was a saying that a French family could live, and live well, on the waste from a typical American table. The waste leak through the garbage-pail was known to be enormous—and, indeed, we were rather proud of it, as an evidence of prosperity.

We've learned better now, and in learning we have unearthed some stupendous facts. For instance, we know that, about the time the war began, there were twenty-nine companies in the United States engaged in rendering garbage for the recovery of grease. They treated 1,200,000 tons of garbage a year, and produced 172,000 tons of tankage—a coarse brown powder which makes fine fertilizer.

How to Save $4,000,000 a Year

Not counting the value of the fats extracted,—a value that was well understood when the war pressed home the need for glycerine from which to make explosives,—the tankage was worth more than $2,000,000 a year; and it has been figured by experts that the installation of rendering plants in all cities of over 30,000 inhabitants would result in a tankage production of more than $4,000,000 annually.

Grease, from which high explosives are manufactured, and tankage were formerly the principal things of use recovered from garbage.

But recently there was announced the discovery of a new method of making fuel from garbage and refuse. This method has been perfected to the point where the government is to conduct exhaustive tests by having one hundred tons of the fuel made in the city of Washington.

Fuel Bricks from Garbage

It's a pleasant thought that, even if we are careless in the kitchen, we we may escape the just punishment for our sins, since in wasting what might have been fuel for our bodies we gain fuel for the furnace. Of course, in carrying out the tests, what the government has in mind is to prevent waste of any sort, to conserve the coal supply, and to cut down the number of cars now needed to move coal from the mines to the consumer.

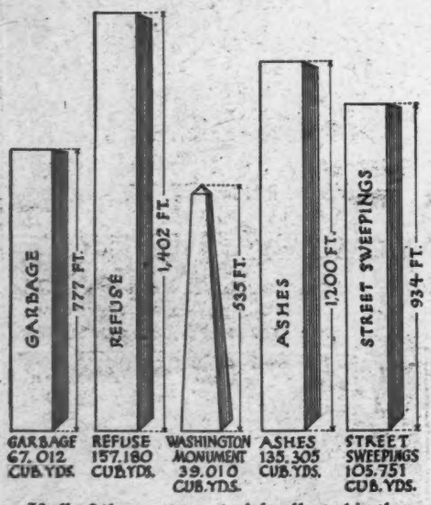
The process by which it is hoped the garbage of yesterday may be the cheerful fire of to-morrow is the invention of E. L. Culver, of Chicago. His plan is to use garbage and coal-dust, the waste from coal-mines, with about seven per cent of tar. For steam purposes no coal-dust is required.

After the garbage is sprayed with creosote for sanitary reasons, it is dumped on a moving belt, where material such as iron, bottles, rags, ashes, and the like are sorted out. The residue is fed to a grinder, where it is pulverized and mixed with the coal-dust. Later it is impregnated with hot water, live steam, and a certain percentage of tar. When the mass becomes pulp-like in form, it is deposited in a brick-making machine, and pressed into fuel bricks ready for firing.

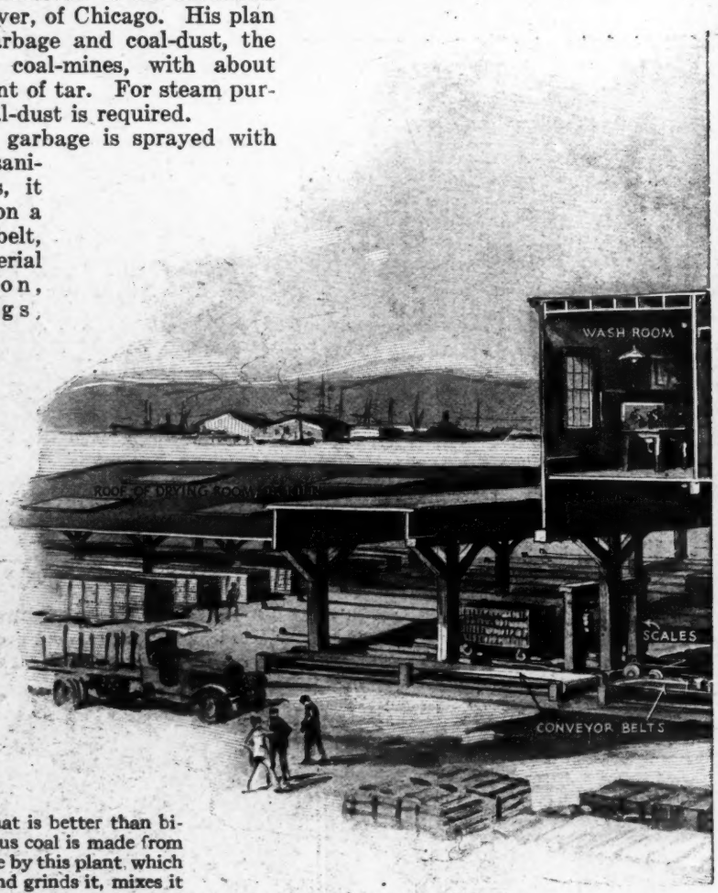
The bricks weigh two pounds apiece, so that one thousand bricks make a ton of fuel. A single brick-machine will turn out twenty-five thousand bricks of fuel in eight hours, or seventy-five thousand in a day of twenty-four hours.

Advantages Claimed for New Fuel

Among the advantages claimed for the new fuel are that it will not slack, no matter how long it may be stored; that it is impervious to water; and that it burns to a cigar-like ash without



If all of the waste material collected in the city of Washington in one year were sorted out into its component parts, and the parts set up beside the Washington Monument, the monument which is 535 feet in height—would be the smallest in the group



Fuel that is better than bituminous coal is made from garbage by this plant, which sorts and grinds it, mixes it with coal-dust, and turns it out in neat bricks weighing two pounds apiece

leaving the clinkers which are so destructive to fire-grates. Bituminous coal has from 9,000 to 12,500 heat units to the pound, and recent tests of the garbage fuel show it to have from 9,000 to 12,920 heat units. The bricks recently sold in Austin, Texas, where an experimental station was set up, at six dollars and fifty cents a ton.

A second plant has been erected in Washington, D. C., where one hundred tons of brick will be manufactured for government officials for testing purposes. Later a larger plant, somewhat similar to that shown in the cross-sectional illustration below will be erected.

Great Heat Value

While burning, the fuel resembles oak wood, and leaves about the same white ash, though its duration and heat value are much greater. Tests have shown that the garbage fuel contains more heat units than the best bituminous coal. For steam purposes, still better results are obtained if equal parts of garbage and coal-dust and from five to seven per cent of tar is made the mixture. The binder thus created holds together about eighty per cent of the coal-dust while it is burning on the grates.

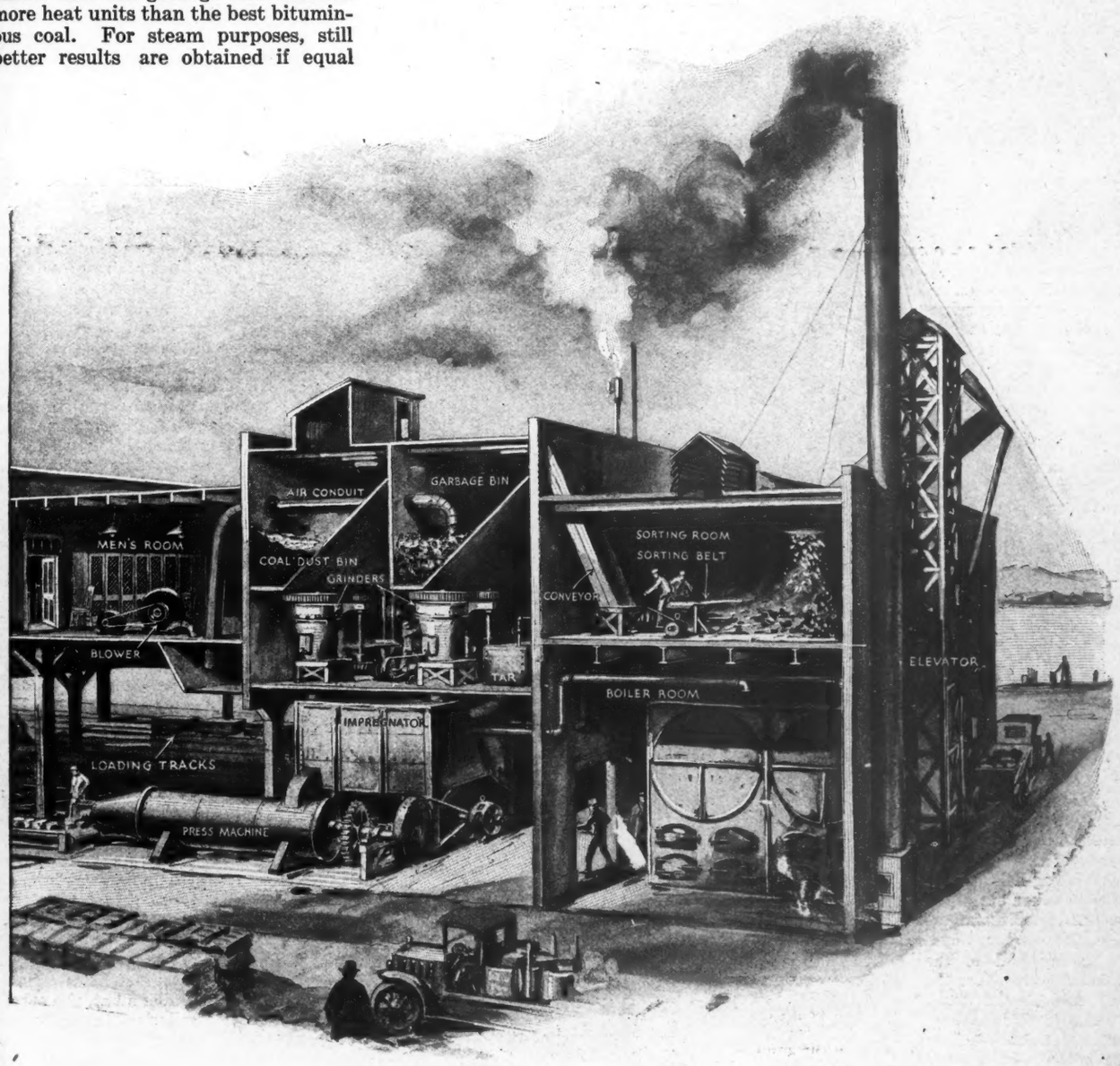
Daily Average Waste per Person

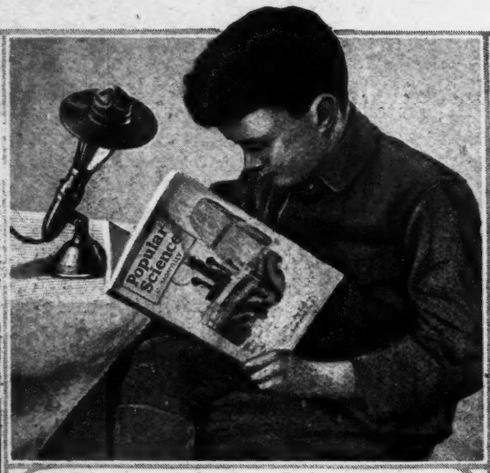
It may be some time before you will be heating your house with fuel born of the garbage-pail; and in the meantime, or at any time for that matter, it is well to recall how large is the waste to be reclaimed. Definite figures can be worked out for the quantities and contents of garbage, in spite of its variable character and amount. According to a report of the American Chemical Society, the average quantity per person is one half pound a day. It consists of 70 per cent moisture, 20 per cent tankage, 3.5 per cent grease, 1.5 per cent bones, and 5 per cent rubbish. This can all be converted into a fuel product capable of being burned over a grate with less trouble than with the ordinary forms of coal.

The fuel that is made in the plant shown below is called oakoal, obviously made up from the words "oak" and "coal." It is so named because in burning it resembles oak wood, and leaves about the same white ash.

Aside from the advantages of the fuel as compared with coal in respect to its greater heating value per pound and less ash, its brick formation makes it easy to handle and to save in storage space, since it can be stacked in regular rows.

It produces no soot and little smoke in burning, so that smoke-nuisance ordinances can be forgotten when it is used. The possibility of spontaneous combustion is eliminated, and there is practically no loss in transportation.





Hats Now Used for Lamp-Shades in the Best Circles

A PECULIAR form of patriotism has broken out among inventors. Everything they invent apes implements of warfare, whether or not they are appropriate. An illustration is this hat lamp-shade.

It is a reproduction of a soldier's hat, and looks as if a small-sized tipsy soldier, if such there be, had come home late the night before and hung it up there.

A Very Independent Clock

APPLE growers and eaters who live in Los Angeles are responsible for the existence of this $5,000 clock. The growers built it in the center of their market-place for the convenience of the buyers. Most of the $5,000 was spent in outfitting the clock with special attachments in order that it might be quite self-sufficient—and it is. It winds itself up when run down, lights itself up at sundown, turns itself off at daybreak, and attends to many other intimate, personal details.

In spite of this versatility, the clock is quite good to look at; for all of its complicated mechanisms are hidden beneath four calm, unruffled concrete faces. Its enormous proportions can best be judged by comparing it with the three men working on it.

Modern Truck and Old-Fashioned Bridge

MANY country bridges were built years ago, to hold a horse and buggy or perhaps a hay-wagon. Then progress brought huge automobile trucks capable of carrying tons, and the frail old bridges began to tremble beneath their weight.

Gaze on the picture above. With a small forest on its back, this truck traveled swiftly toward the bridge. When half way across, the rear wheels broke through the 2½-inch planking, and the truck came to a standstill. It is evident that such old bridges should be rebuilt.

You Can See Them Grow

TREES grow so slowly, and the consumption of full-grown ones is so great, that before long we shall have to take to substitutes.

A telephone company has planted in California, for use as telephone poles, the forest of bamboo shown above. Southern California is particularly fertile, and bamboo forests planted there sometimes grow to a height of sixty feet in a single season. The stalks in the picture grew as much as eight inches in one day.

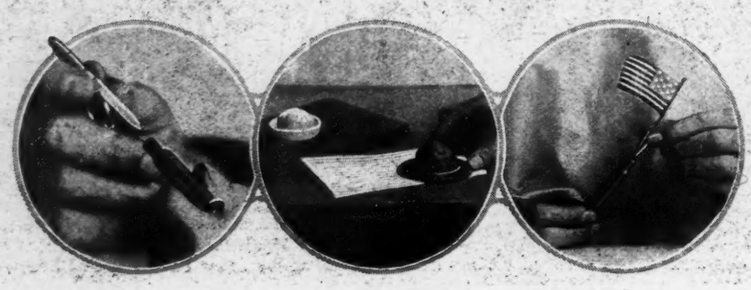
Each new year the stalks become thicker, longer, and stronger. They came originally from Japan and China, and are used there in house and bridge construction, for piping water, and for making furniture.

Already we have some bamboo furniture, and perhaps in time we'll have the other things too.

Some Little Things that the War Has Brought Us

BULLETS have been mustered out of service, now that we are no longer shooting Germans, and they have had to hunt around for new jobs. These two have found good ones—excellent examples for other ambitious bullets.

One of them is working as a flag-holder. The bullet is taken out of the shell and the flagstaff attached to the blunt end. The sharp end of the bullet is inserted into the shell, and so the bullet is transformed into a flag-holder. The other one holds down a more serious job. A blade is attached to its blunt end, and thus it becomes a penknife.



Knickknacks like these, reminiscent of army days, are very popular now—so much so that people are now using metal paperweights molded in the form of different parts of soldiers' and sailors' equipment.

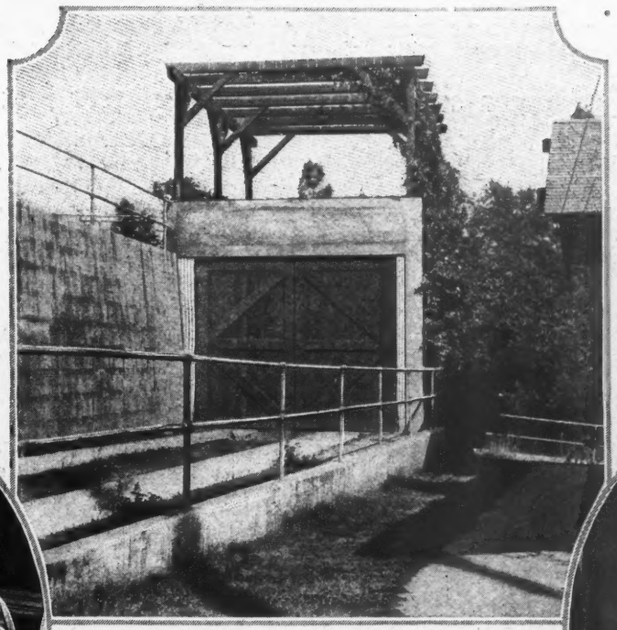
Here, for example, are a pair of hats; one is a soldier's hat, the other a sailor's. In shape and color they are exact imitations of the real thing.

Take the Key and Lock It Up

THE lock shown in the picture below looks like a clamp, and acts like one.

Suppose you wished to fasten together the handles of a bag. You would pass one of the arms of the lock through the handles, clamp it shut, and lock it.

The lock may be applied to almost anything. This homeward-bound soldier proves it.



With One Hand She Knits for Soldiers

ONE persevering woman has refused to let the loss of her right forearm make her helpless. So when our fighting boys clamored for sweaters and socks she decided that she would knit some.

Under her crippled arm she tucks the needle carrying the work, and with her one hand she both guides the thread and works the other needle.

Roof-Gardening on Top of a Garage

A MAN living in southern California was faced with the problem of building a garage and a pergola in space enough for only one. Finally he decided to build the pergola on top of the garage. The garage is of concrete, and the pergola of wood. Rose and ivy vines are being trained over it.

The roof-garden would undoubtedly be a delightful place to visit—if one knew how to get up there.

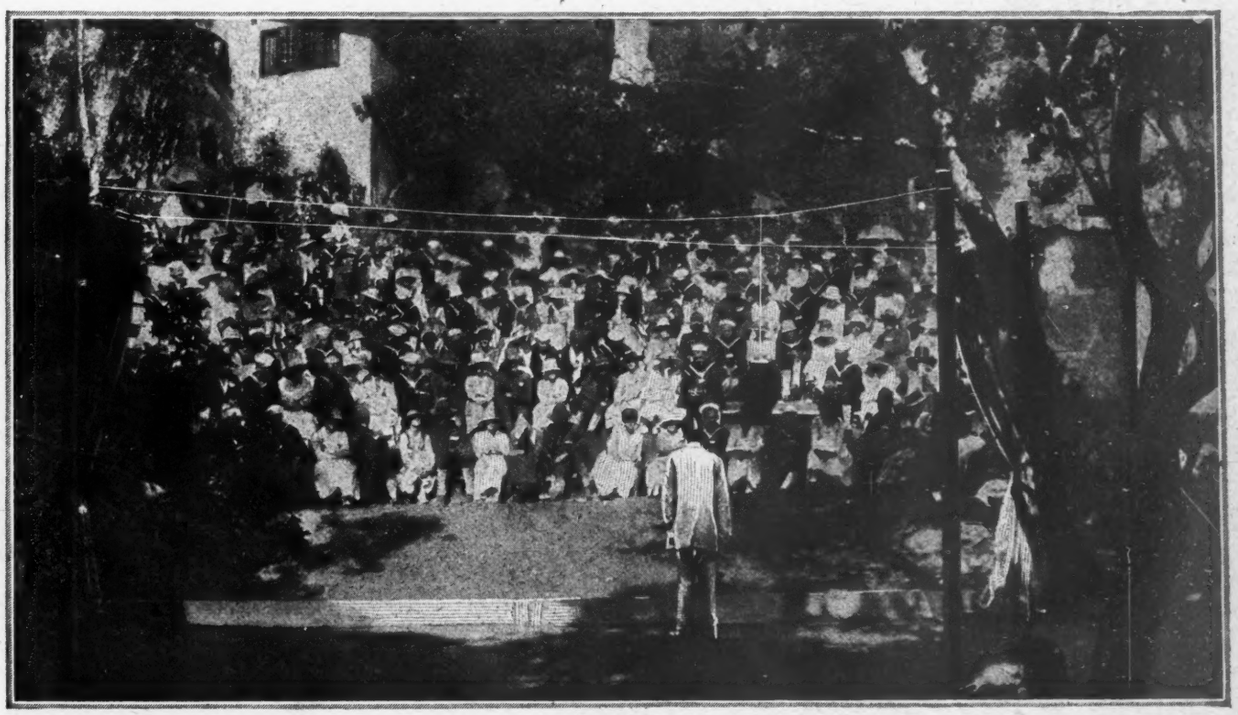
Elocutioning in His Front Yard Instead of Hiring a Hall

TO hire a theater each Sunday in which to recite the poetry you have written during the week would be an expensive undertaking.

A Californian poet, Charles Keeler, had this great desire to pass on his weekly creations to an admiring audience, and he hit on an economical way of doing it. His front yard was shaped just like an amphitheater. Fifty dollars' worth of blasting on the rocky, sloping sides resulted in tiers which would seat an audience of three hundred. The resulting theater is hedged in by large oak and bay trees.

In this rustic setting, Keeler recites his works each Sunday, using for his stage the bare ground.

A glance at the picture shows that our army and navy boys have poetic souls.



Compressed Air to the Rescue

How a submarine, sunk in ninety feet of water, was raised and its crew saved

By Robert G. Skerrett

THE British had a rod in pickling for the German Grand Fleet if the Kaiser's sea force had ventured forth again. To be specific, the instrument of chastisement consists of a flotilla of very large submarines of a new type, and the purpose for which these boats were built was the forming of a mobile ambuscade just where the foe would be least likely to look for under-water craft. They were designed to have exceptionally high surface speed and to be capable of accompanying a battle squadron to distant zones of operation offshore, and there to submerge and lie in wait for the enemy's armored squadrons.

The present story has nothing to do with the details of construction of these powerful submarines other than to say that they are not propelled by internal combustion engines, but are driven, instead, by steam-turbines when operating at the surface—steam making it possible to attain greater speed, and possessing other technical and military advantages.

Spectacular Feat of Salvage Corps

Now, one of the conditions that have handicapped the employment of steam in submarines has been the great amount of heat radiated by the boilers, and the well-nigh insufferably high temperature of the boiler and engine spaces; and it is upon this fact that the present story turns. Several months ago, the British authorities gave an outline of some of the spectacular work carried out to successful climaxes by the Salvage Section of the Admiralty. Among these performances was the raising, by means of compressed air, of a vessel which had gone to the bottom in water ninety feet deep. The public report did not describe the type of craft; but it has since become known that the vessel in question was one of the big steam-driven submarines mentioned.

The boat foundered on her first deep-water trial trip: to be exact, she went to the bottom when making her initial dive. She had aboard of her at the time not only a full crew but nearly double that number, and among the extra personnel were certain high officials of the Admiralty. There were fully ninety people inside of her when she was headed seaward.

A Strange Oversight

It is not certain whether the presence of so many inquiring spectators or the newness of the crew led to confusion and oversight at a critical stage of the maneuvers, but it is known that the primary cause of the disaster was the failure to close some of the ventilators over the boiler and engine spaces before the boat submerged!

In all probability, the steam plant heated the craft to an uncomfortable degree, and in order to secure relief the ventilators were kept open aft, and this was forgotten during the execution of certain orders immediately preceding the fateful dive. As a result, the vessel no sooner settled below the surface than water poured in violently through the unsealed ventilators; and, before the descent of the submarine could be halted, hydrostatic pressure increased the speed and force of the invading flood, sending her bottomward like a dropping stone.

Half of the people on board, those in the space aft, were drowned. Those forward were trapped and seemingly doomed.

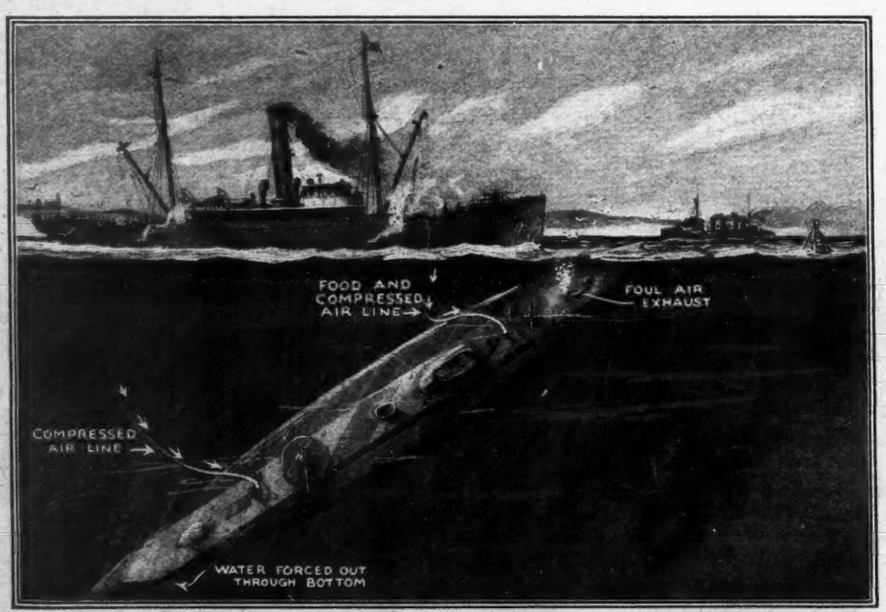
Happily, the submarine was under escort, and the bubbles of air escaping surfaceward steadily from a fixed position occasioned alarm. Divers were promptly brought to the site and sent down. They discovered the foundered boat. Their hammer blows upon the hull were answered by tappings from within the unflooded interior, and signals were exchanged telling the nature of the accident and the predicament of the survivors.

Fresh Air Forced In

The first concern was to save the lives of those in the forward half of the boat, and it was realized that air would have to be supplied them before the confined atmosphere became too foul to sustain life. To this end, hose connections were made through the outer deck by way of existing fittings, and fresh air was forced into the vessel while the tainted air was withdrawn at another point. From time to time, liquid food was sent down through the hose to the imprisoned men. These relief measures were continued for a day or more.

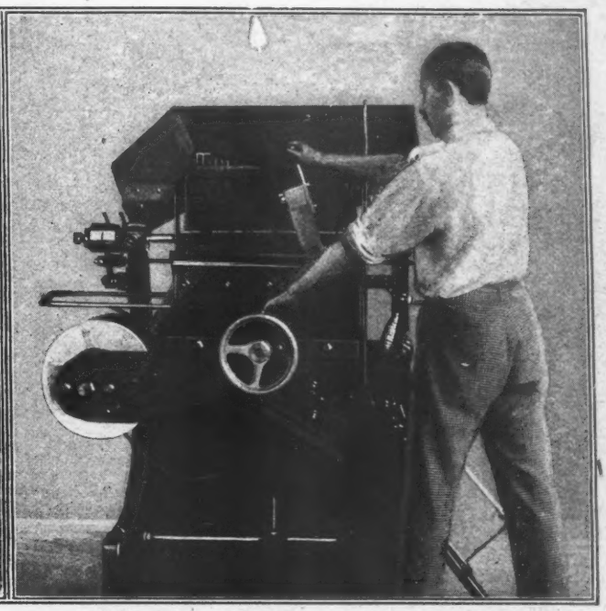
In a somewhat similar manner, compressed air was forced into the flooded after half—entering through the top of the pressure-resisting hull and driving out the contained water through an opening which was cleared in the under side of the submarine's shell. Sufficient buoyancy was finally obtained in this manner to cause the boat to bring her bow above the surface. Then, by means of oxy-acetylene torches, an opening was cut in the exposed deck and a way cleared for the escape of the forty-five survivors within. The submarine was next towed to port, dry-docked, and refitted for service.

This salvage achievement stands without a parallel.



Liquid food was sent down through the hose to the imprisoned men, and finally the submarine was forced to the surface by compressed air

This simple cutter for saplings works on the scissors principle, the operator simply pulling the handle



With this machine it is possible for one person to pack nails at the rate of 2,400 pounds an hour

Clipping Down Young Trees

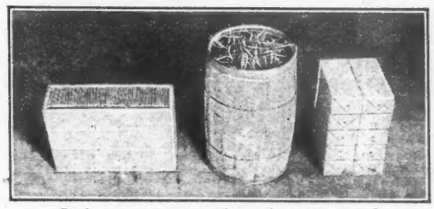
MR. GEORGE ULRICH, a Wisconsin farmer, decided to make a meadow out of some land of his on which there was a large growth of young trees. He and his son started hacking them down with scythes and axes — the usual way of clearing land. In a short time the scythes grew dull and the men became tired and discouraged. This led Mr. Ulrich to invent, as a quicker and easier means of cutting the trees, a tool that works on the scissors principle.

The base of the instrument is U-shaped, and has a very sharp front edge. Attached to this base is a handle, hinged so that it can travel back and forth. On the handle, near the bottom, is a curved arm on which there is a V-shaped blade.

The farmer places the base of the cutter on the ground, with its sharp edge against the tree and the curved arm around it. Then he pulls the handle, as shown in the illustration above, and the tree is swiftly and easily clipped off.

Anybody who has ever performed the back-breaking task of cleaning a piece of woods for planting will register a silent "thank you" to the inventor of this useful device.

An Electromagnetic Nail-Packer



It is easy to see the advantages of the modern method of packing nails

WHAT promises to be a revolution in the manner of handling nails has been started by an electromagnetic packing-machine. Instead of being thrown helter-skelter into kegs, where much of the space is lost, the nails are neatly arranged parallel to each other in cartons or boxes.

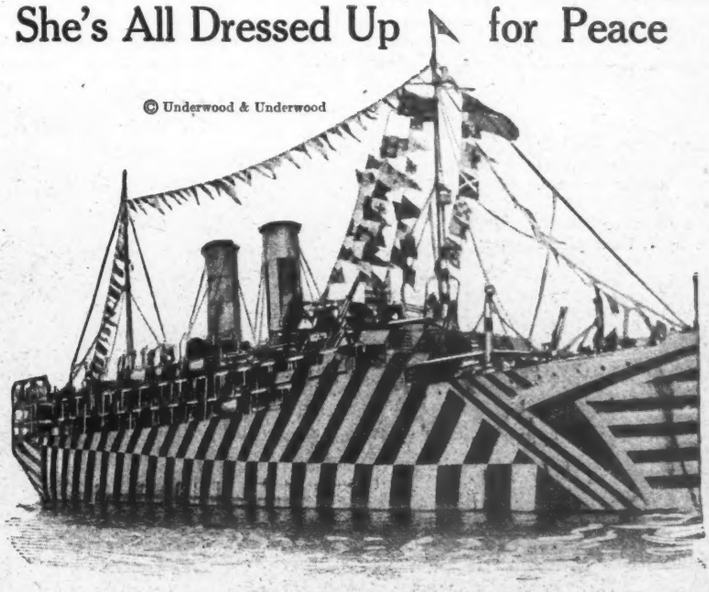
The machine is highly ingenious, though simple in principle and in operation. It is based on the principle that linear iron objects, when in a magnetic field, take up a position in the direction of the lines of force.

The nails are dumped into a feed-trough in lots of about a thousand pounds. A shaking device causes them to glide into the paralleling mechanism, where, freely falling, they are paralleled with mathematical exactness.

After the nails are paralleled, a lever cuts out the current and presses the nails into a tray which is fixed between the two magnet poles. The sheet-iron tray then swings downward, and the nails are emptied from it into the packet by a slight jerk.

After a little training one operator can put up from 600 to 2,400 pounds of nails in ten-pound packets in an hour. The current required can be taken from the ordinary circuit, and amounts to only one or two kilowatt hours in an eight-hour day.

She's All Dressed Up for Peace

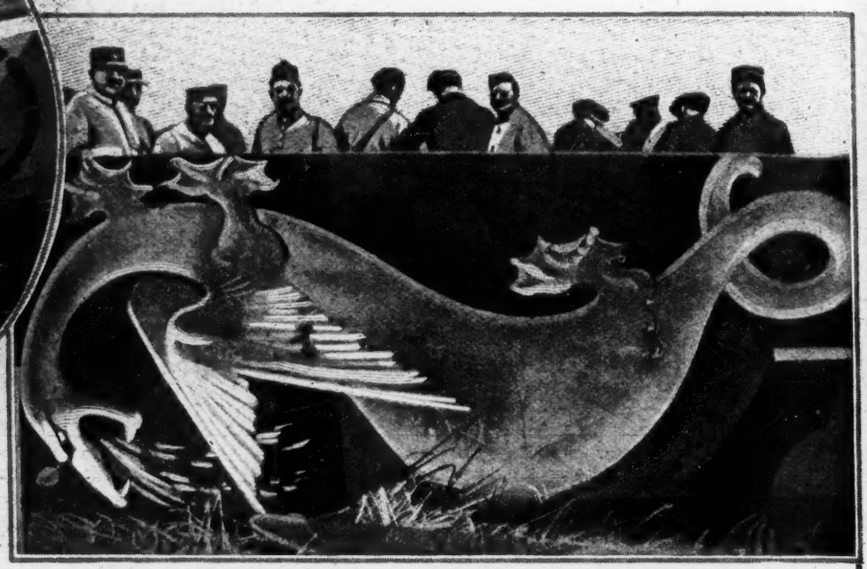


At news of the signing of the armistice, every ship in New York harbor put on her prettiest dress, togging up in bunting and signal flags from truck to taffrail. The English vessel shown here was already decorated with a riot of camouflage. The war over, the censor allowed her to be photographed with all her face-paint on

Modern Knights Errant Create

They blazon their devices on airplanes as

An interesting feature of the Great War was the revival by the air fighters of traditions and practices of knight errantry. Just as the knights of old wore distinctive devices, so the chivalry of the air placed distinctive markings on their airplanes

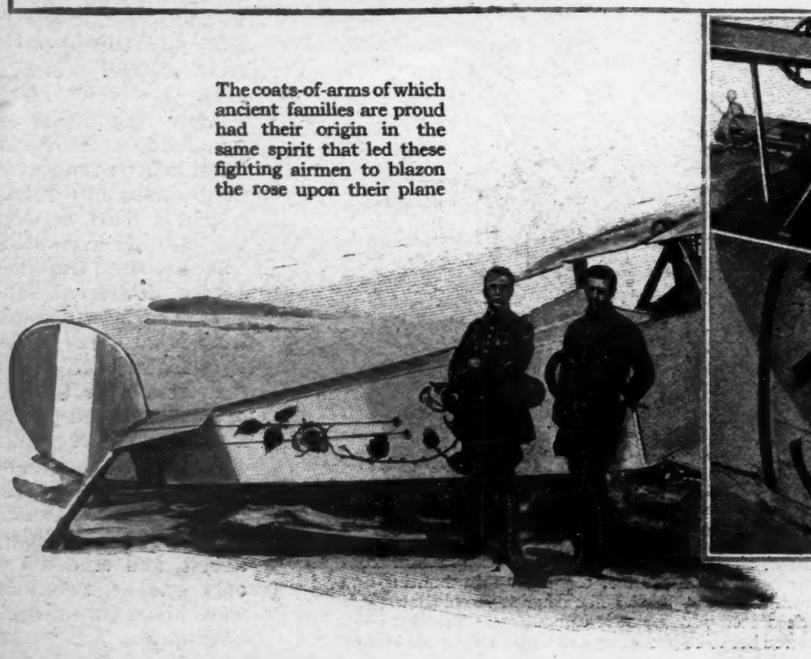


We have to show this interesting beast upside down because the Hun plane he decorates fell that way. The ancient griffin, or gryphon, guarded treasure

One French flyer sought inspiration from the ancients, choosing as his device the symbol of speed and wisdom

Fritz likes boastful heraldry—here we have the Bavarian lion chasing the French cock. How that rooster came back!

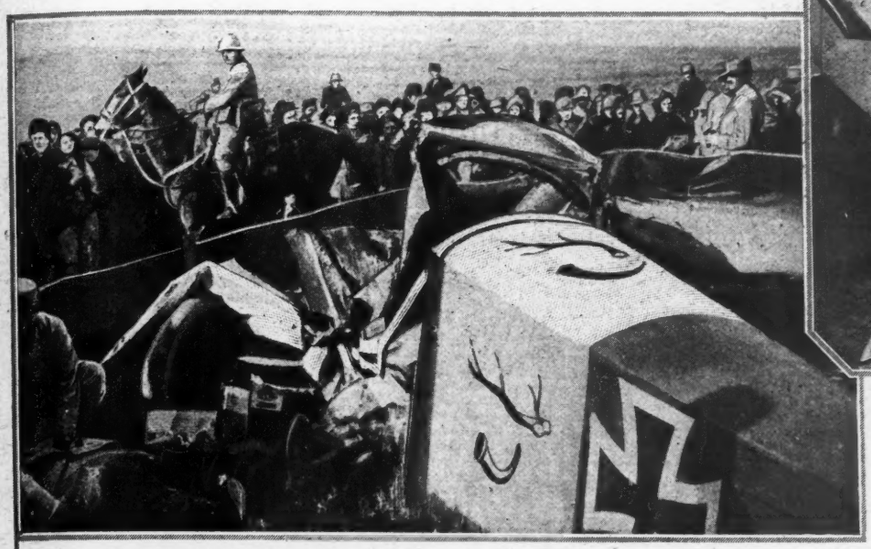
The coats-of-arms of which ancient families are proud had their origin in the same spirit that led these fighting airmen to blazon the rose upon their plane



A Lafayette Escadrille flyer, who, while short on heraldry, evidently believed implicitly in the magic combination of the mystic 13, his lady's name, and the United States shield

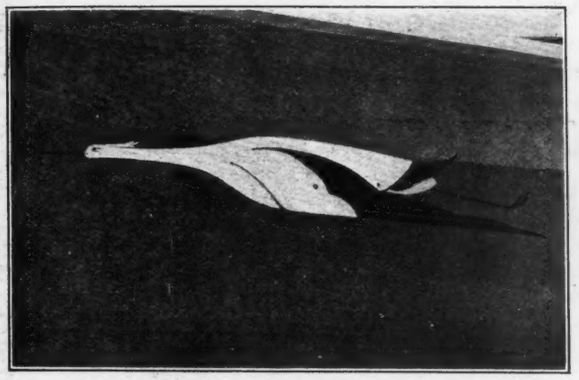
a New Heraldry of the Air

warriors once did on shield and armor



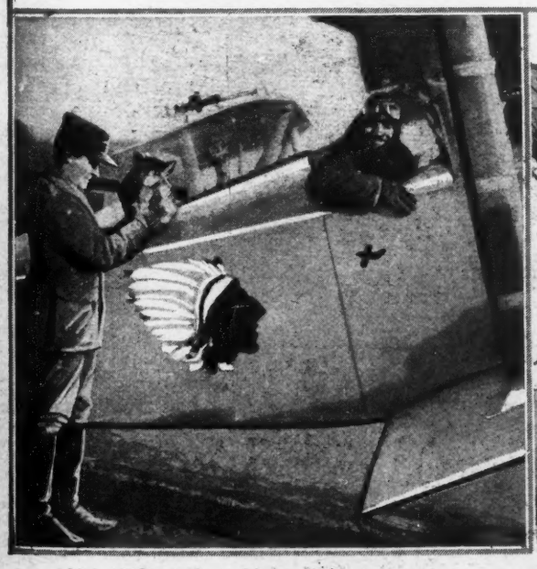
The "sporting" element of individual combat, quite missing from modern war on the ground, still lives for the air fighters, as this German plane indicates

A Belgian version of the Indian head. When knighthood was in flower, this device would have been handed down from father to son, and would have been emblazoned on the flag flying from the family castle. It's hard to be picturesque and democratic at the same time

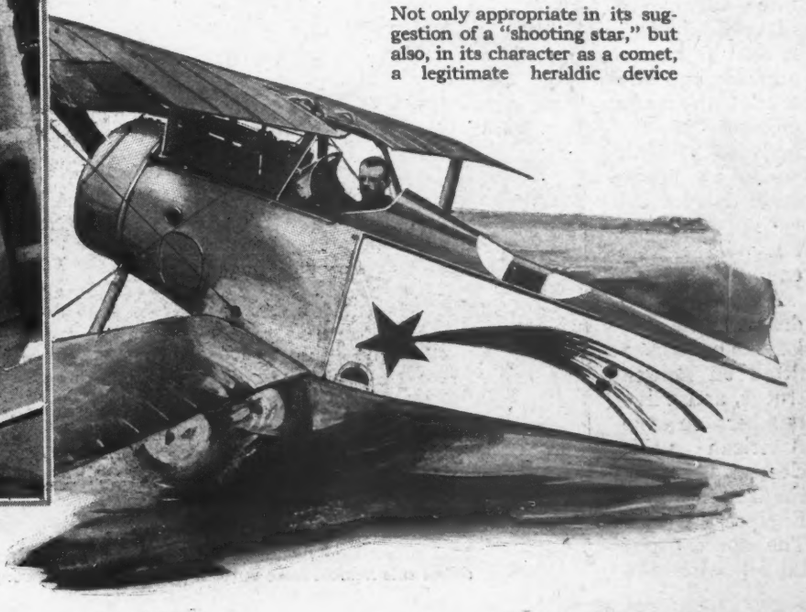


Like the "one-shield" knights of romance, the Stork Escadrille flyers carried one distinguishing emblem on their planes

Does the dove seem out of place on a fighting plane? Well, the stork is supposed to be in other business, too



The "Tête Noire" (black head) device and fighting name of the old Norman is recalled by this Indian head on our modern hero Lufbery's machine



Not only appropriate in its suggestion of a "shooting star," but also, in its character as a comet, a legitimate heraldic device

Know What Your Trucks Are Doing

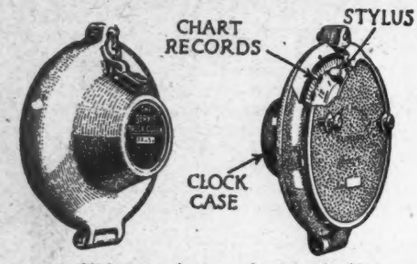
WHEN a truck-owner sends his trucks out for the day, he has no means of keeping any check on his system. If a driver is out for a long time and accomplishes little, it is difficult to know where the fault lies. With a service recorder like the one illustrated attached to a truck, every move the truck makes is recorded with absolute accuracy.

The principle it works on is this: a truck in motion sways from side to side. There is a pendulum in the recorder which swings with the truck when traveling. Behind the pendulum is a chart rotating at clock speed.

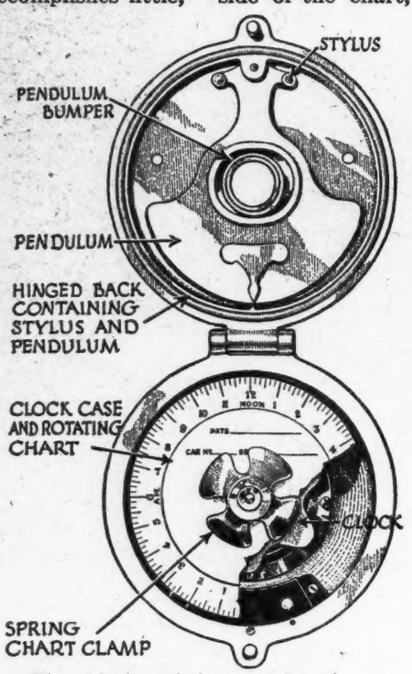
As the pendulum moves, it records the movement on the chart by means of a stylus that is set in the pendulum near its point of suspension. Thus the time when the truck is traveling and the time when it is standing still show up plainly on the disk in black and white. The driver adds his record at the side of the chart, and this record can easily be verified if necessary. The section of a chart shown below will give an idea of how this is done.

The advantages of this recorder are many. For instance, it took more than an hour for the truck to load. This denoted bad system in the loading department, which was promptly investigated. Then, too, there will be no arguments between driver and boss in regard to time and overtime, for the recorder tells no lies.

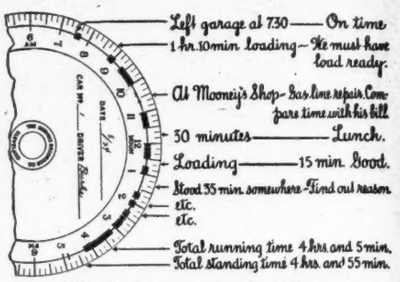
If the driver covers a great distance in a very short time, the boss will know he has been speeding.



This recorder may be attached to any part of the motor-truck



The swinging of the pendulum is recorded by a stylus on a rotating chart


Left garage at 730 — On time
1 hr. 10 min. loading — He must have load ready.
At Mooney's Shop - has line repair. Compare time with his bill
30 minutes — Lunch.
Loading — 15 min. Good.
Stood 35 min. somewhere - Find out reason
etc.
etc.
Total running time 4 hrs. and 5 min.
Total standing time 4 hrs. and 55 min.

This is the way the chart looks at the end of a day's traveling

Turn a Crank and Shovel Out the Load

IT was not long after the beginning of the war when the British Royal Engineers, intrusted with keeping French roads in shape, found that they would have to devise some unloading means for handling road material.

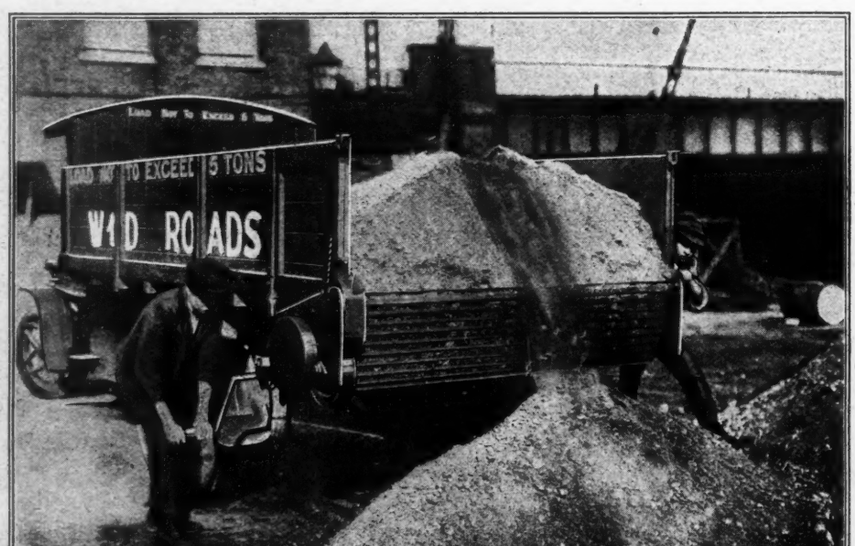
It was this condition that led Lieutenant W. Owen Wilkins to invent the unloading device here illustrated. One of the main advantages of the equipment is that it can be applied to any truck without any changes in the body itself, such as would be necessary if the common type of American body hoist were employed.

About four hundred of the unloaders have been fitted on British trucks, and a like number on the American vehicles serving with the United States Engineer Corps. The success obtained with the apparatus may be gaged by one test in which two men unloaded a three-ton load of ballast in thirty seconds.

The apparatus consists of a flexible false bottom, which is placed inside of the ordinary body and supported on longitudinal metal skids placed on wood sills placed lengthwise. The false bottom carries the load, and is provided with a vertical steel plate near the front end of the body.

The entire false bottom, which is made up of laths or slats of steel mounted on a flexible base, is moved backward and over a roller at the rear and slightly above the end of the truck-frame and thence down and around a roller underneath.

This winding up of the false bottom, which is effected by two men working crank handles, moves the vertical steel plate backward, shoving ahead of it all the material carried and pushing it off on to the ground. A wire rope brings the plate back to the front for the next load.



Two men unloaded three tons of ballast in thirty seconds with the aid of this flexible false bottom placed inside the body of the truck

This New Motor-Truck Hasn't Any Springs

Cylinders like this may replace springs on motor-trucks

A NEW type of motor-truck has no springs, and yet it is said to "ride" more easily than a passenger car. This is accomplished by the substitution of four telescoping cylinders, which open and close on a body of oil and air, each cylinder working independently and operating against the pressure of a central equalizing tank.

One of the cylinders is attached at each corner of the truck-frame and to the axles below it. An oil lead from each cylinder is connected with the central equalizing tank, filled with common cylinder oil and air under pressure. The initial pressure in the equalizing tank is provided by a small engine-driven pump, and is afterward regulated by an ordinary valve on the dashboard.

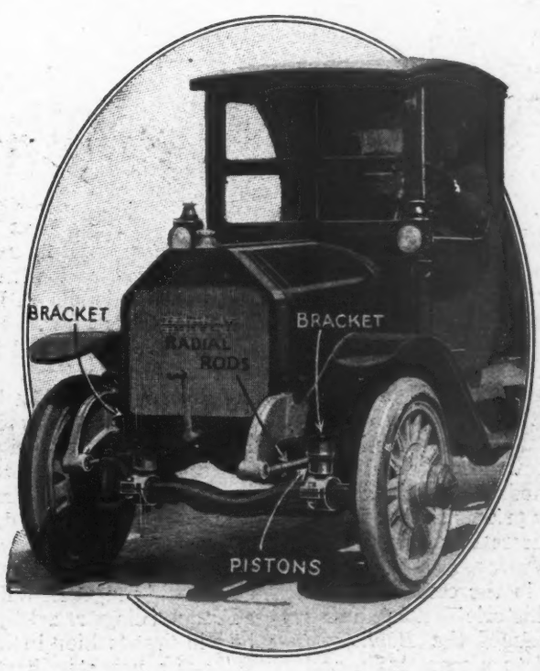
Each cylinder is joined to the axle by means of a ball-and-socket joint, the upper or outside telescoping portion being pivoted to the frame at points in a line drawn parallel with the longitudinal center-line of the truck. This removes all side strain from the cylinders.

At the rear, the usual radius rods are employed to take the driving strains set up by the motion of the truck. At the front, however, a set of flexible radius rods, resembling the main leaf of a spring, take care of the side sway.

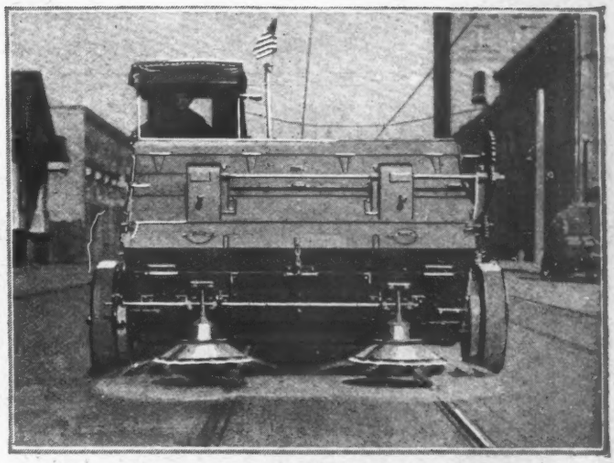
While simple in principle, the path of the oil through the cylinders to the central tank is quite complicated. The inside telescoping cylinder which is fastened to the axle is provided with a hollow main sleeve, or tube, which extends upward into the hollow piston and piston-rod of the upper or outside cylinder attached to the truck-frame. The hollow main sleeve has ports cut into it near the bottom, and these are opened and closed automatically to allow the oil to flow from beneath the piston to the equalizing tank as the axle moves up and down on rough roads.

To understand just how the sleeves work, imagine that the cylinder fastened to the axle is suddenly displaced upward in striking a bump. The pressure on the oil beneath the piston is increased, and this drives the auxiliary sleeve upward against the pressure in the equalizing tank and a balance-spring inside the sleeve until the oil is discharged through the ports into the main sleeve, and then upward and out to the equalizing tank line.

During this operation, the outside follow sleeve has not moved. The piston then moves downward, forcing the follow sleeve down and opening the main sleeve ports and closing the auxiliary ports until all the main sleeve ports are open. When the piston is within half an inch of the bottom, all the ports are closed to prevent any metal-to-metal contact.



The radial rods take care of the side sway of the truck; the cylinders support the load



The sanding device on this street-sweeping machine may also be used for distributing seeds on farm-land

Making the Street-Sweeping Machines Work Overtime

IN large cities the street-sweeping machines are usually kept pretty busy; yet there are times—for instance, in wet and foggy weather—when they are idle for many hours at a time.

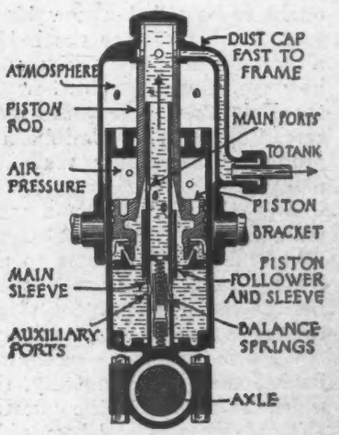
Peter J. Owen, the superintendent of the street-cleaning department in San Francisco, has increased the usefulness of the automobile street-sweeping machines of his department by a simple expedient which is likely to be adopted in other large cities.

He removed the trap-door in the front or the rear of the sweeper, and put in its place an attachment consisting of two sand-spreaders, which are geared to be run at two speeds.

The sand is carried in a box on the chassis of the car. The sanding attachment can be mounted on the sweeper in less than one hour, and is very useful on wet and foggy days, when the streets are slippery.

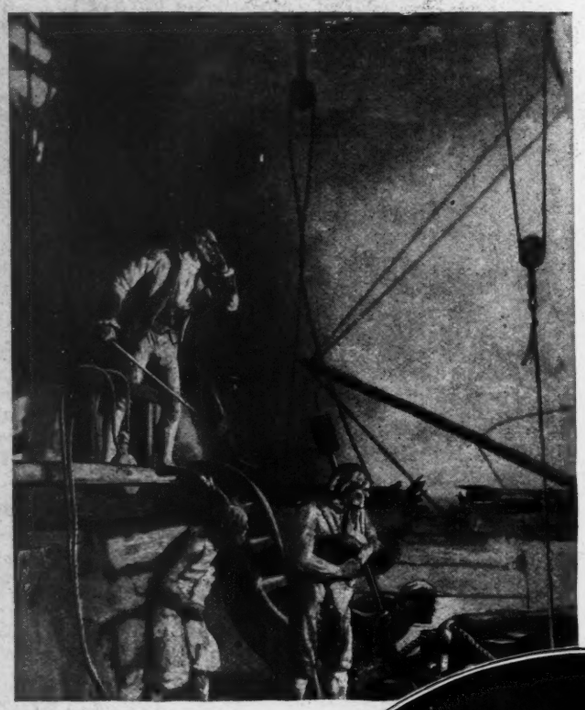
The sand provides the necessary friction to prevent horses from slipping and falling and automobiles from skidding. It is also of great value in removing the oil dropped from automobiles—this oil being highly injurious to the smoothness of bituminous road surfaces.

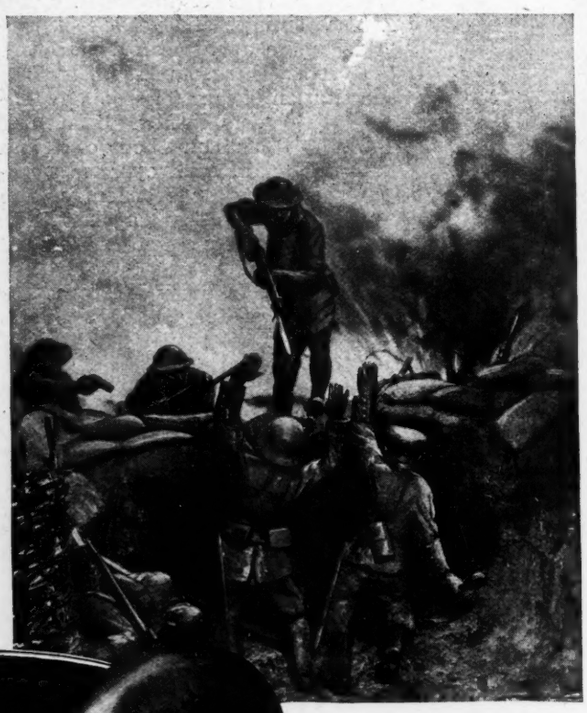
This sanding attachment can also be placed on a lighter chassis, and may be used for planting seeds on farms.

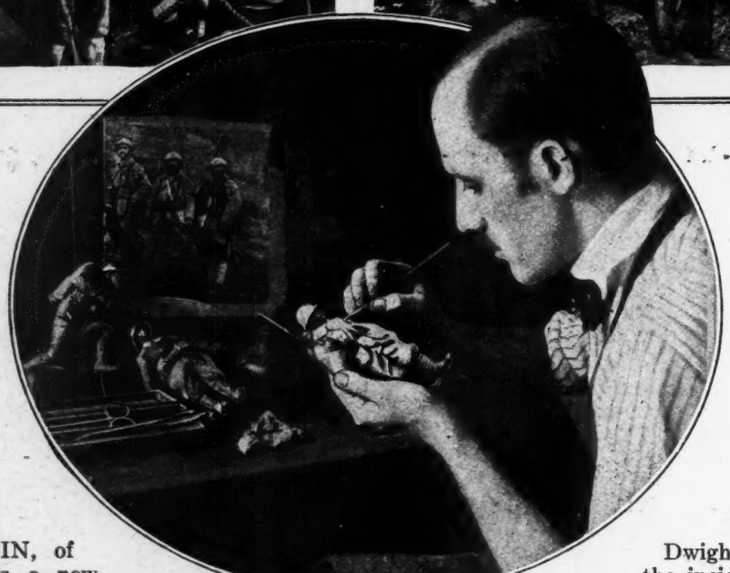


How the sleeves of the telescoping cylinders work

Scientist and Artist Too







"I have only just begun to fight!" Dwight Franklin makes live again that moment on the deck of the sinking *Bonhomme Richard* which made Paul Jones one of the immortals

Dwight Franklin is a new kind of artist-scientist. He has had to develop his own technique. All of his materials—paint, metal, plaster, wood — are handled with equal skill

"Kamerad!" It was a great moment in history when the marines at Château-Thierry stopped the German rush for Paris. In interpreting subjects like this, Mr. Franklin imparts to his model real dramatic action. While the model is not new in museums, it has hitherto been both accurate and dead. In his new art Mr. Franklin applies, on a small scale, the very principles successful producers of plays employ

DWIGHT FRANKLIN, of New York city, is a new kind of artist. Perhaps he ought to be called a new kind of scientist, too. He delves into the hidden past by making a thorough scientific study of how the cave-man lived, how the Vikings fought, how George Washington crossed the Delaware, or how the pirates of the Spanish Main spread terror in the Caribbean Sea, all for the purpose of producing startlingly realistic and minutely accurate models.

Now, the model is not a new piece of apparatus in the museum; but in the past it has been both accurate and dead. Dwight Franklin imparts to the model dramatic action. He applies, on a small scale, the very principles that David Belasco and other successful producers of plays employ to stir the souls of their audiences.

What is the most striking event in the career of John Paul Jones? Undoubtedly, that historic battle during which he stood on the quarter-deck of the *Bonhomme Richard*, when it had been reduced to a mere hulk, and responded to his British adversary's demand for surrender with: "I have only just begun to fight!"

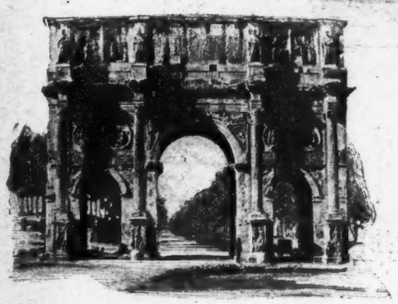
Dwight Franklin dramatizes the incident. He makes a model of the deck. He places on the deck little figures, fashioned with a real artist's feeling and with a jeweler's painstaking regard for minute detail. In a word, he stages John Paul Jones and his crew. He mounts the setting in a box, like a little stage, and illuminates it with a keen sense for the dramatic effect. And the result? The scene lives.

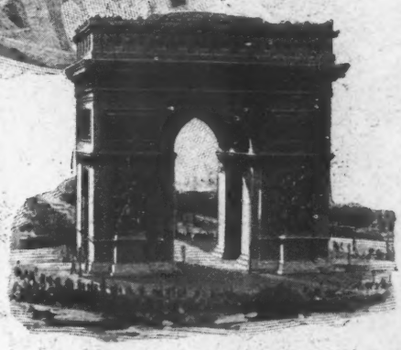
As yet Mr. Franklin has no competitor in his scientific dramatizations. His work, exhibited in the Metropolitan Museum of Art and in the American Museum of Natural History, finds no counterpart anywhere.

Franklin has had to create his own technique. Plaster, wood, clay, cardboard, metal—all materials must be worked with equal skill and facility in order to produce the effect desired. He will spend hours, even days, in carving and piecing together a little chair. If the charred ruin of a French village razed by German guns is to be represented, he will first fashion little beams and then burn them.

Thus a new step has been taken by a man who combines the plastic sense of the sculptor with the scientist's love of truth.

Here is the Chinese idea of a handsome memorial arch. An emperor of the Ming dynasty placed it at Peking centuries ago





Beneath These Arches Fame's Highroad Passes

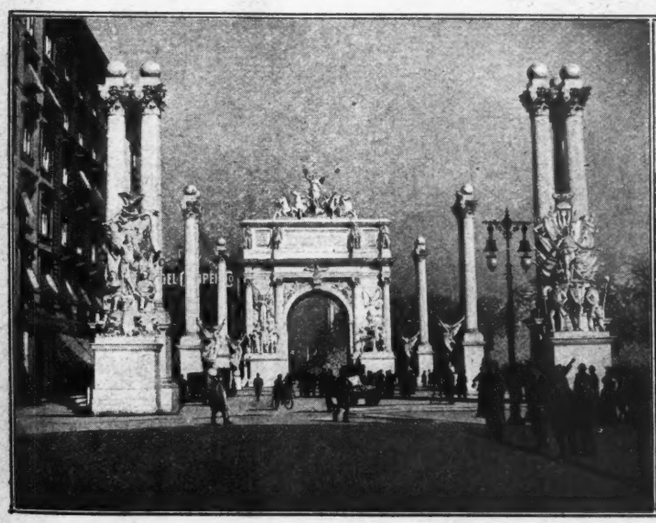
It was the Romans who set the fashion of spanning public thoroughfares with huge ornamental arches, usually built to commemorate victory. This one, the Arch of Constantine, built in the year 315 A. D., is one of the best preserved of all ancient Roman monuments

Most famous of all modern triumphal arches, the great Arc de Triomphe de l'Etoile in Paris. Napoleon began it in 1806, and it was completed a decade after his death. The total cost was more than twenty million dollars

When the Yanks come marching home. Sketch by Thomas Hastings of an arch of welcome on Fifth Avenue

The Dewey Arch was built over Fifth Avenue, New York, to welcome the Admiral from his triumphs. To be ready in time, work was rushed day and night on the structure and on the plaster-of-paris statues that adorned it. In spite of the hurry, critics agreed that the arch possessed impressive dignity and beauty. It stood 100 feet high and the flimsy materials weighed more than ten tons

Were things done now as in the old days, Germany might be suffering from falling triumphal arches; and, as it is, the Brandenburg Gate in Berlin—under which Bismarck marched his captive Danes, Austrians and Frenchmen—has gone out of the triumph business. In the time when the "Me und Gott" partnership flourished, only Wilhelm could pass through the central opening



New Devices that Ought to Make Housekeeping Easy

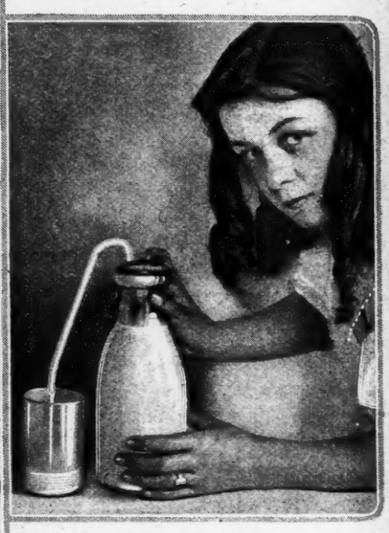
A long platform for the electric washing-machine, rinsing and bluing tubs, and the basket, making a continuous operation from start to finish

A solid comfort chair which can be made into an invalid chair. The foot-rest and tray are removable. A button in the right arm regulates the back

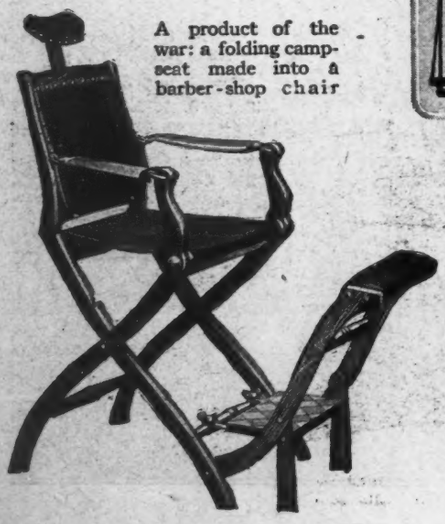
One of the newest devices for cutting an apple into slices and coring it at the same time

A new door-bolt for closing a door tightly to prevent draft: it can be locked with a padlock

Sanitary glass receptacles for tea, sugar, etc. They are arranged conveniently on shelves



A glass tube and rubber cover for skimming milk in the bottle. The cream is removed by pressing the cover



A product of the war: a folding camp-seat made into a barber-shop chair

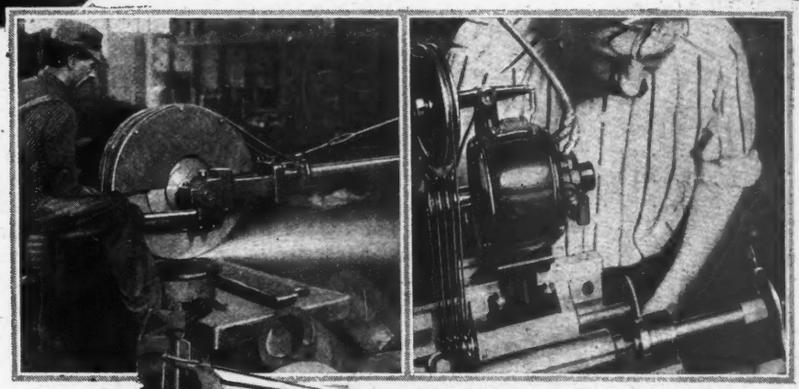
This chair does away with the necessity for a telephone-desk. It has a place for the telephone-book and a swinging arm for the receiving-stand

Machines That Were Built to Hooverize Material and Labor

The scrap material that accumulates around every shop becomes a problem in large factories. This baler bundles it like paper

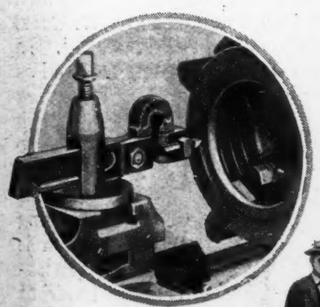
A small and almost automatic electric lighting plant for houses. It is so simple that a small child can start it

A device on the truck shown in the picture above reduces the labor of the handling of kegs to a minimum

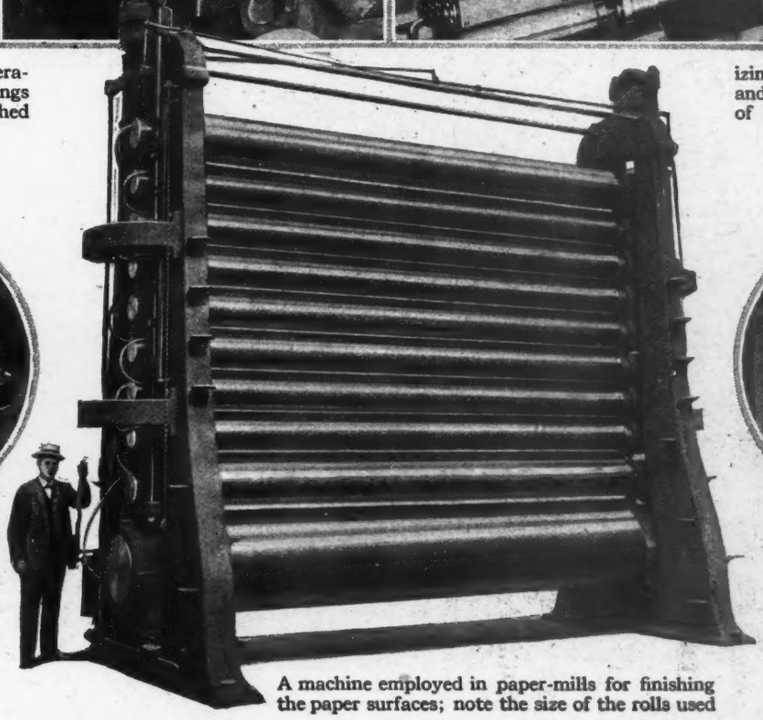


With the aid of a large emery-wheel mounted on a moving arm, many difficult grinding operations on heavy castings may be accomplished

A tool that makes the thread gages that are so necessary in standardizing bolts and screws and in the manufacture of modern machinery

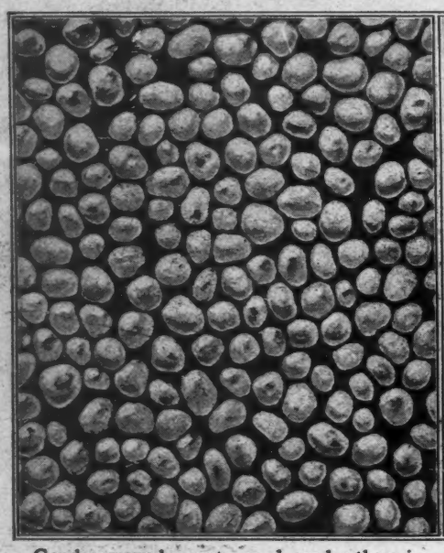


The goose-neck of this finishing tool relieves the chatter and gives a perfectly smooth cut where it is used in a lathe or planer



A machine employed in paper-mills for finishing the paper surfaces; note the size of the rolls used

During the war it was necessary to seal all metal cans sent abroad, even those containing biscuits. Above is an electrically operated tool for sealing



Good screened quartz sand, under the microscope, looks like a mass of pearly pebbles

This machine, with a crew of four men, will pick up and place in position ninety rails an hour

Little Grains of Sand

QUARTZ is the most valuable component of sand. It occurs in enormous masses, without definite crystalline structure. Quartz sand, under the magnifying-glass or the microscope, looks exactly as a handful of pebbles looks to the naked eye. These minute pebbles are more or less rounded and polished by attrition, but they vary in size and color. The picture accompanying this article gives an excellent illustration of the appearance under the microscope of good quartz sand composed of pebbles of uniform size. This uniformity of size is obtained by shifting the sand through screens of fine mesh.

Formerly it was believed that sand, to be effective for sand-blasting, should consist of mineral particles with sharp, irregular corners. A careful study of the subject with experiments has since shown the fallacy of this theory. Such particles, as a rule, can be obtained only by crushing crystals. These rapidly split into smaller crystalline particles, and eventually become crystalline dust without abrasive power. It was found that quartz pebbles of uniform size and nearly spherical shape are best suited for sand-blasting.

Best of all are those without crystalline structure, because they do not split and splinter into dust, and hence last much longer. Owing to their great hardness, they can be blown against hard surfaces without breaking, and their uniform size and roundness give to the surface treated by them a smooth, even finish.

A Machine that Lays Railway Tracks

DO you remember the old railway-building days? Hundreds of men with picks and shovels graded the the road-bed; trucks with gigantic wheels and drawn by many horses hauled the rails to the right of way and distributed them along the roadway. It required from sixteen to twenty men to carry each rail from the truck to its temporary resting-place, and just as many to put it in position as part of the track.

At the present time one steam-shovel, guided by three or four men, takes the place of that army of men with picks and shovels. Powerful tractors carry the rails and other material in a fraction of the time it used to take, and a light derrick-car with four men picks up and places the rails in position at the rate of ninety rails an hour.

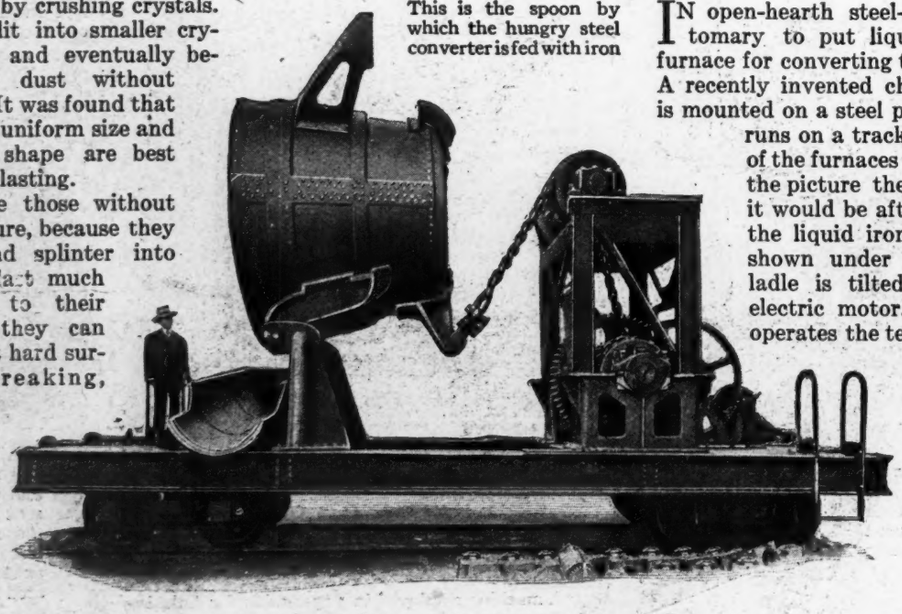
The picture above shows one of these derrick-cars. The power for running the car at the rate of from four to sixteen miles an hour is generated by a four-cylinder gasoline engine, which also supplies the power for hoisting and lowering the rails.

One man operates the engine, two men are required to steady the ends of the rail, and the fourth man attaches and detaches the rail tongs. The levers are operated from the driver's seat.

The car, with its machinery, weighs only 4,500 pounds. If desirable, trailers may be attached to the car, in which to carry laborers to and from work.

Administering Doses of Liquid Iron to Steel Furnaces

This is the spoon by which the hungry steel converter is fed with iron



IN open-hearth steel-making it is customary to put liquid iron into the furnace for converting the iron into steel. A recently invented charging apparatus is mounted on a steel platform car which runs on a track close to the doors of the furnaces to be charged. In the picture the ladle is tilted as it would be after it had emptied the liquid iron into the trough shown under the ladle. The ladle is tilted by means of an electric motor. Another motor operates the telescoping charging trough, which is placed transversely in front of the spout of the ladle. The liquid metal runs through the charging trough and into the furnace.

Can We Beat Our Swords into Plowshares?

It is difficult to salvage the giant war machine, once it goes to the scrap-heap

By Hudson Maxim

THERE is none too much war material in the world to-day for the use of the world if a peace-keeping league is formed. The war material should be divided among the nations according to their needs, and then each nation should be permitted, under the league, to produce only a certain limited quantity thereafter. A breach of this understanding would put that particular nation under a ban.

But, assuming that the material is not to be so disposed of, and that there is to be no adjustment between the Peace League nations to distribute the war material among them for future war needs or world police needs, then the question arises, to what peace use can the material best be converted?

From War to Peace

The tanks, especially the smaller or whippet tanks, largely used by the French, could doubtless be converted into tractors. The tank itself is merely a tractor converted from peace to war use, and it would be a very simple matter to convert the tank back again from war to peace use. Few of the farms of France are large enough for the individual farmers to own tractors for their farm-work, but proper arrangements could doubtless be made, either by the government or by private companies, to supply tractors for all-round farm use, on terms that would be acceptable to the small French farmers.

In the Ukraine, however, and other parts of Russia, there would be a wider use for such reconverted tanks, but they would not have very much value even for that purpose. It would be much simpler, with our means of quantity production in this country, to produce tractors specially designed for the work. At best reconverted tractors could never compete with tractors made especially for farm use.

The main value of war material at the present time lies in guns, ammunition, and ships. These guns and the projectiles made for them would have no value except as old metal. The same is true of shoulder rifles. A shoulder gun that cost, say, $50 to make might bring fifty cents or a dollar. Big cannon costing $50,000 to build might be worth from $100 to $200.

As to Airplanes

The cost of transportation and breaking up of the big guns must be taken into account. The same holds true of the big shells. They would bring as old metal only a very small fraction of their original cost. Therefore, if one per cent of the guns and ammunition could be sold for what it is worth for war uses to the smaller nations, it would be a better bargain than it would be to attempt to reconvert or utilize for other purposes all the material there is.

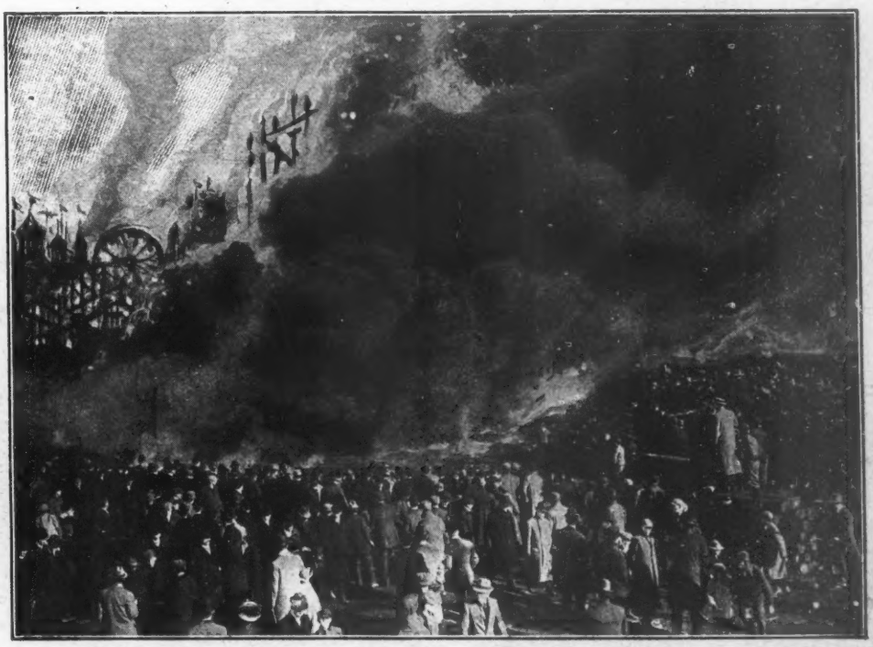
The airplane engine, of which the Liberty motor is a very good example, is a very highly specialized product, made for the purpose of generating the maximum power for a given period. Every part of it is just as strong as every other part, and it has been so tested and timed and tuned that when it goes to pieces it practically goes to pieces after the manner of the one-horse shay. Such a motor is not intended for continuous use. It is intended only for a brief and strenuous use, and the life of the Liberty motor under full load or running at a speed where it is doing its best, I believe, is only about eighty hours.

Some of the airplanes, especially the bomb-carrying airplanes, may have a use as mail-carriers or for similar purposes; but such use is at the present time largely problematical.

There is one war measure that will have the very largest kind of peace use. I refer to the establishment of plants for the fixation of atmospheric nitrogen. Had the war continued a little longer, we should have had some very large and well equipped plants which could in time of peace be utilized for making fertilizer; but most of the work on these plants has now been arrested.

Fixation of Atmospheric Nitrogen

There is no one thing more needed in this country, as an industrial development, than plants for the fixation of atmospheric nitrogen, particularly for the manufacture of fertilizers for agricultural use. The government ban should be taken off waterpower throughout the country, so that individual enterprise may utilize that power



Great conflagrations could be staged as spectacles every sixty days, at a sum far less than that which is represented by Niagara's wasted waterpower

"Whippet" tanks could be converted into tractors. The one pictured here was used as such in dragging its own fuel supply up to the front in France

for the synthetic manufacture of fertilizers.

All of the water passing over Niagara Falls should be utilized to produce electricity for industrial uses, and a large amount of this could very well be applied to the manufacture of fertilizers. There is practically an unlimited demand for cheap fertilizers for the farms.

Many of these power plants could be shut off in order that the water might be returned to the falls periodically for scenic purposes; but even then it would be a very costly display.

Niagara's Wasted Power

It is estimated that 16,000,000 horsepower is running to waste at Niagara Falls. To produce this power with modern steam boilers would require 32,000,000 pounds or 16,000 tons of bituminous coal an hour. If such coal were tc. be appraised at $3 a ton laid down at the plant, the 16,000 tons would be worth $1,152,000. That would be the daily cost of the coal supply to produce that amount of power. The value of the water that is wasted is therefore about $300,000,000 a year. This in gold would weigh 450 tons.

A conflagration the size of the great London fire could be provided once every sixty days for public entertainment and amusement for a sum equal to that which is running to waste at Niagara Falls.

The burning of Rome by Nero was a very inexpensive piece of amusement compared with that which is provided for bridal couples who visit Niagara Falls.

Enormous quantities of tri-nitro-toluene—that is to say, T.N.T.—and nitrate of ammonia have been made into high explosives. The best way to employ these materials for peace use would be in the manufacture of high explosives. Stupendous quantities of high explosives are made in the United States annually for industrial use. To a considerable extent, however, T.N.T. would have perhaps the higher value for industrial purposes. Nitrate of ammonia is one of the best fertilizers in the world, and would be worth for farm use all that it cost to produce it.

The most important use to which war material could be adapted for a period of peace is the machinery that has been constructed during the war for the manufacture of war materials. There are vast quantities of such materials, and large buildings have been erected for the manufacture of war implements. Nearly all of this machinery is very readily adaptable to the manufacture of implements of peace.

Huge cannon, which cost $50,000 to build, are worth only a few hundred dollars when sent to the scrap-heap

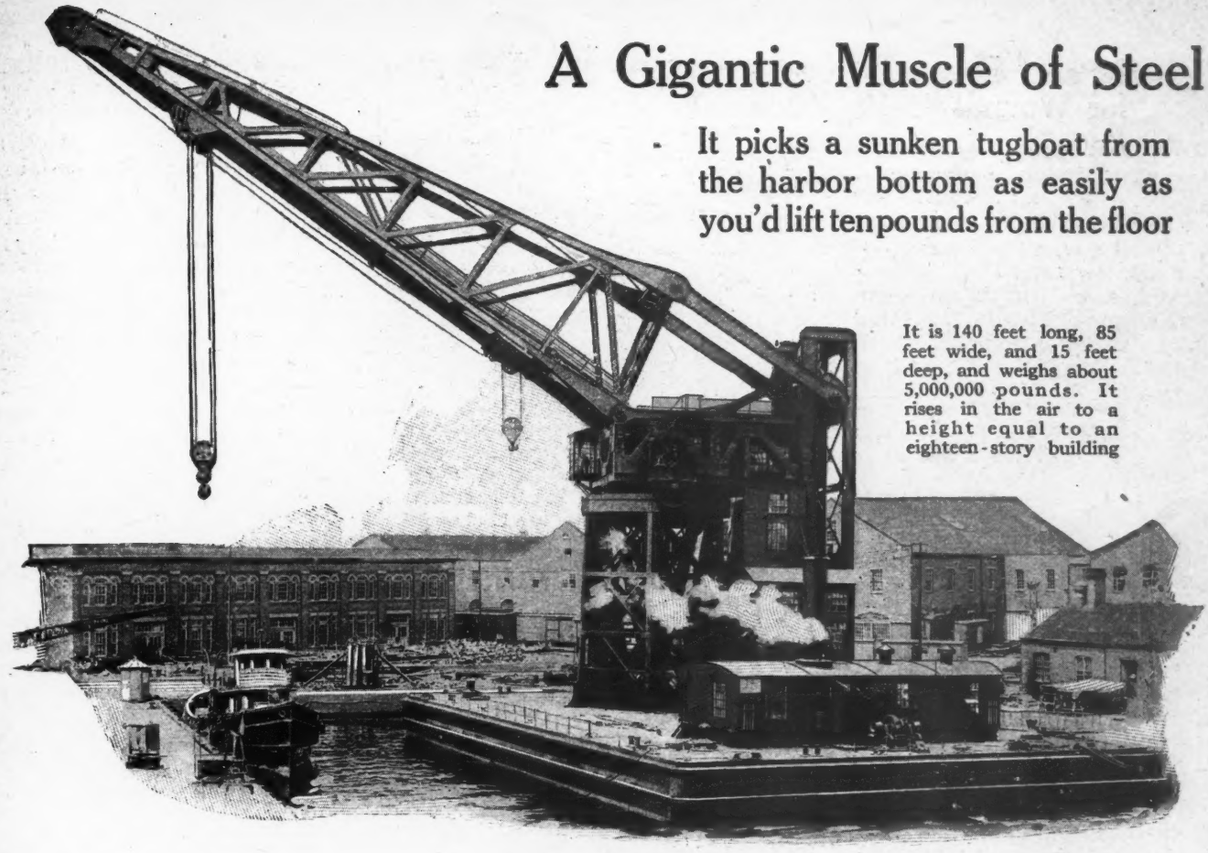
Valuable War Machinery

For example, the buildings that have been erected and the machinery that has been installed in them for the manufacture of war tanks can very well and profitably be employed for making farm tractors and automobiles and heavy trucks for industrial use.

The vast equipment for the production of airplane engines can very readily be utilized in major part of automobile and farm tractor engines. One of the largest manufacturers of munitions of war in the vicinity of New York is already planning to launch out in a large way in the production of harvester machinery.

A Gigantic Muscle of Steel

It picks a sunken tugboat from the harbor bottom as easily as you'd lift ten pounds from the floor



It is 140 feet long, 85 feet wide, and 15 feet deep, and weighs about 5,000,000 pounds. It rises in the air to a height equal to an eighteen-story building

WHEN the navy tug *Massasoit* was accidentally sunk in one of our Eastern harbors a few months ago, a gigantic floating crane, which had then just been put in service by the Navy Department, was subjected to a severe test.

Its First Test

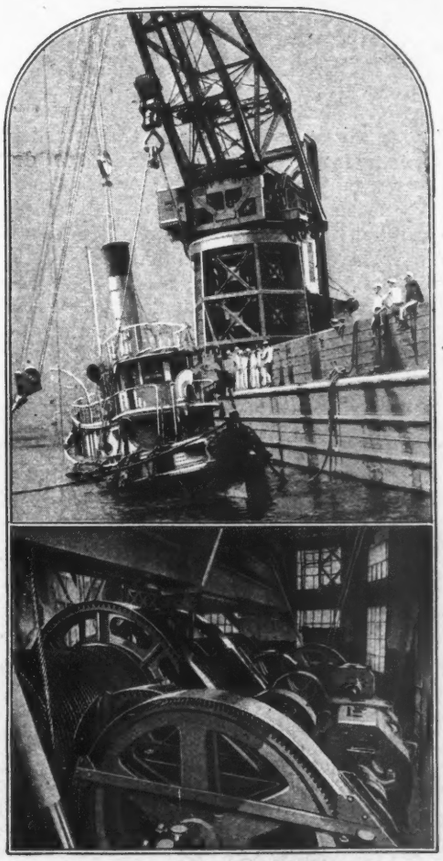
It was the first work of importance for which the new crane—the largest of its kind that has ever been constructed in the United States—was employed, and naturally the result of the test was awaited with considerable interest in engineering circles.

The crane stood the test perfectly. After divers had passed the necessary cables under the tug, the huge apparatus lifted it to the surface in a remarkably short time.

Mounted on a Flat-Boat

It is difficult to form a correct idea of the enormous size and power of this piece of machinery, even from the accompanying picture. The flat-boat, or pontoon, upon which the crane is mounted is 140 feet long and 85 feet wide and has a depth of 15 feet.

The jib of the crane, when it is raised to a vertical position, has a height of more than 200 feet, a height greater than that of an eighteen-story building. The total weight of the crane with all its machinery aggregates 5,000,000 pounds. The counter-weights, which balance the movable part of the crane, weigh 600,000 pounds.



This powerful machinery, which one man can operate by means of levers and controllers, is the invention that is lifting the boat in the picture just above—the United States Navy tug *Massasoit*, which had sunk to the bottom of the harbor

On a Circular Track

The crane is fixed upon a base which is permanently fastened to the framework of the pontoon. It rests upon a circular track, on which it may be turned in any direction upon a horizontal plane. The boom, which may be lowered from a vertical position to one forming an angle of thirty degrees with the horizontal, is of the cantilever type, and is strong enough to lift a load of more than 150 tons, the equivalent of the combined weight of about one hundred average touring cars. The empty lifting-hooks alone weigh about two tons.

Operated by One Man

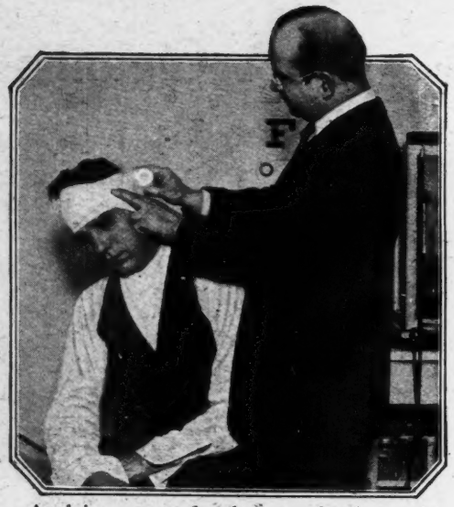
The flat-boat contains a complete boiler plant and an engine-driven generator which supplies the electric current for operating the various motions of the crane, which are controlled from a small cabin mounted high above the deck. By means of a few levers and master controllers, one operator is able to control all the functions of the crane with the utmost precision.

Brakes are provided to stop the entire hoisting machinery, should the electric power fail suddenly while the crane is at work.

Use of Paper Dressings for Wounds

WE have been familiar with paper towels, napkins, and table-cloths for some time. We have heard that the German people are using paper for clothing. But paper used for surgical dressings is something new. Dr. Alfred Kahn, of the New York University Medical College, has been using paper instead of gauze for surgical dressings, and has found it exceedingly satisfactory.

The material he uses for internal dressings or drains, either wet or dry, is blotting-paper. This may be prepared in a variety of ways, so it is suited to all surgical uses.



Applying a paper bandage to a head wound. Paper is lighter and cheaper than is gauze

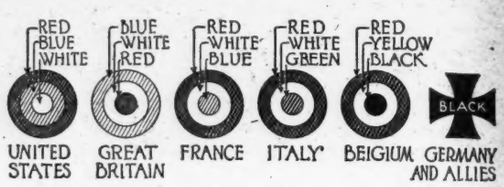
Paper bandages have much the same appearance as have gauze bandages. They come in the same neat rolls of different widths. The paper is rendered sterile just as gauze is sterilized, and may be used with perfect safety. In dressing a wound where it is necessary to use internal dressings, the internal dressing of blotting-paper is held in place by paper bandages. The bandage is applied exactly as a gauze bandage would be applied, and fastened with strips of adhesive paper tape in much the same way that packages are fastened by strips of gummed paper.

Both paper dressings and bandages are lighter than gauze, and are therefore more comfortable for the patient. Often a heavy cotton dressing is burdensome. Other advantages possessed by paper dressings are that they may be removed far more easily than cotton dressings, and may be destroyed.

How to Tell Whether They're Right

WHEN the United States first joined the Allies, some of our airmen sported a star within a circle as the insignia of our air service. It was not long before the need for distinguishing marks of greater uniformity was felt, and we adopted the insignia of concentric circles used by our Allies, the only difference being in the colors. This caused some confusion to artists, and they often got French or English color arrangement on American airplanes.

In an attempt to help readers to distinguish between the planes when they see them in illustrations, the symbols below have been given their print or magazine value rather than their actual color value.



A study of color values that will enable you to check up the magazine illustrators of flying stories

Counts and Wraps Coins Quickly and Accurately

THIS ingenious mechanical device is capable of counting and wrapping all kinds of coins—gold, silver, nickel, and copper. It consists of a counting-board, a separate counting-tube for each denomination and size of coin, and separate brass tubes for stacking and wrapping.

The process of operation is simple. A handful of coins of any denomination are placed in a counting-tube of the right size. The tube is then run rapidly over the grooved tracks of the counting-board, where they are deposited.

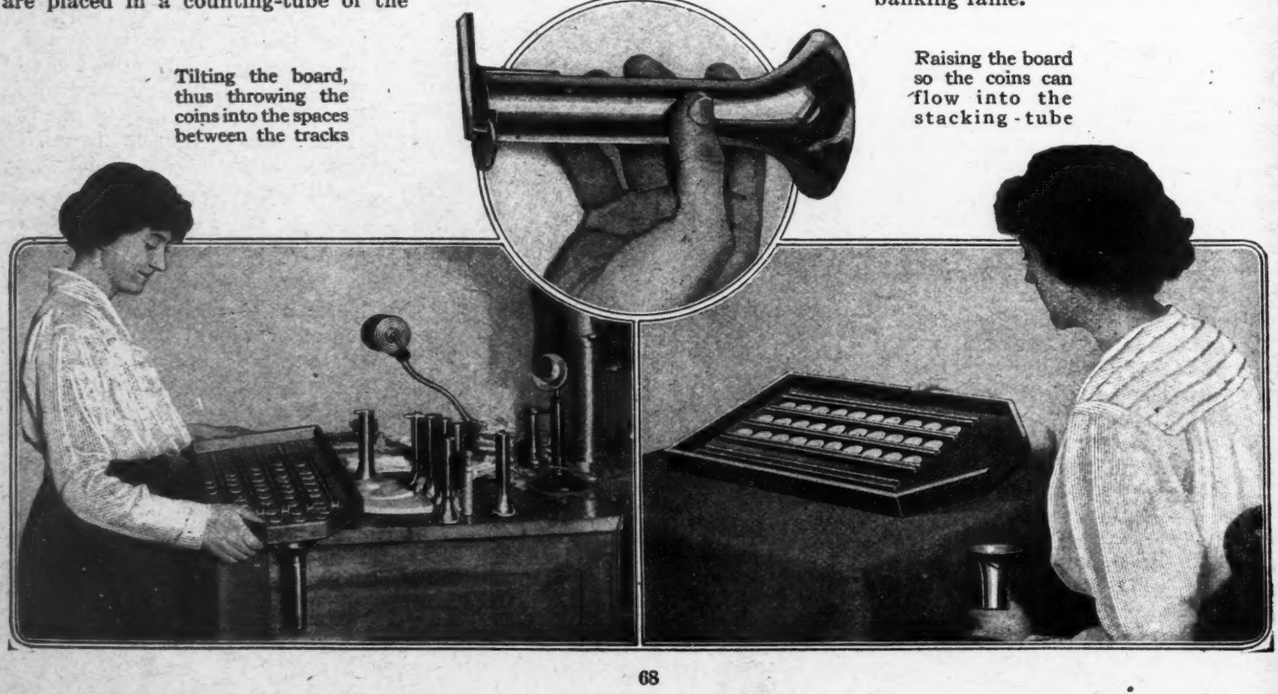
Each track holds only ten coins. When the coins are all placed on the tracks, the board is slightly tilted, thus throwing the coins into the spaces between the tracks. One end of the board is then raised, and the coins quickly run down the aisles into the stacking-tube attached to the end of the tray.

This tube contains a paper wrapper, which can easily be closed when the tube is opened.

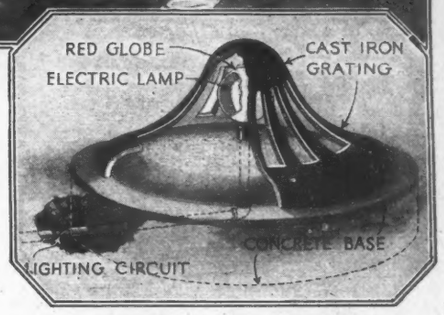
Formerly coin-counting was a job for an expert, but this machine equals in speed and accuracy the best of the old-time money-handlers known to banking fame.

Tilting the board, thus throwing the coins into the spaces between the tracks

Raising the board so the coins can flow into the stacking-tube



Picturesque markers for making streets safe for vehicles and pedestrians



Traffic Congestion in City Streets

One suggestion for relief takes the form of a novel safety island

REGULATING the traffic in congested city streets is an exceedingly difficult problem, made even more intricate by the fact that, as a rule, the streets that have the greatest vehicle traffic are also the main arteries of travel for pedestrians. Where a street with exceptionally heavy traffic is crossed by another equally crowded with vehicles and pedestrians, the difficulties of regulating the traffic become enormous. Street railways add to the complication.

Duties of the Traffic Police

Consider one of these crowded streets at the busiest time of the day. Two continuous lines of vehicles are moving in opposite directions. A driver may wish to turn into a side street. To do so he must cross the path of the vehicles going in the opposite direction, necessitating a break in the line. The carelessness or recklessness of a driver who tries to "butt" his vehicle through the line because he happens to be in a hurry may cause a collision or, worse, a breakdown, throwing the entire traffic at that point in confusion. If the line of vehicles extends through several blocks, it is quite possible that traffic for a mile or more will become paralyzed.

In large cities the regulation of street traffic is under the control of the police department. Stringent rules governing the movements of vehicles in congested districts are enforced by special traffic policemen; yet, in spite of rules and traffic policemen, accidents are of frequent occurrence. One of the commonest causes of such accidents is the disregarding by some reckless driver of the rule which provides that a vehicle turning into a cross street to the left must make its turn so that it reaches the proper side on the cross street before the car has completed crossing the main street.

For the guidance of drivers, safety islands of various designs have been placed in the center of the roadways at street intersections. Most frequently they consist of a raised circular platform of stone or concrete, surmounted by a post with an electric light at the top.

Danger in Usual Island"

Safety islands of this kind, although they are perfectly efficient and safe as long as the drivers of vehicles observe traffic regulations, become a source of danger when these rules are disregarded. Chauffeurs, taking chances when there is comparatively little traffic and the vigilance of traffic policemen is relaxed, sometimes cut across on the wrong side of the island and smash into the lamp-post.

Suggestion from Bureau of Mines

To diminish the danger of such accidents, Mr. Otto H. Mohr, head of the illuminating engineering department of the United States Bureau of Mines, has devised a safety island of a novel type. It consists of a concrete cylinder, about two feet in diameter, set in the road-bed at the center of street intersections, so that its base is less than an inch above the street level. The top of the island, to be of an ornamental dome shape, bears a red light, and has a cast-iron cover with radial slits through which the rays of light pass.

The entire structure is not more than a foot in height. The form of the top has been carefully chosen with regard to the possible effect if an automobile should run against it. If the impact is of sufficient force, the cast-iron top will be knocked off and slide forward, but no serious damage will be done to the island or to the vehicle.

Finding Your Way In the February Skies

Read these monthly articles and the star paths will soon be as familiar to you as the streets of your home town

By Ernest A. Hodgson, *of the Dominion Astronomical Observatory*

ALL the stars visible to the naked eye, and many more that are invisible without optical aid, have been accurately surveyed, catalogued, mapped, and named by astronomers. A sixth-magnitude star is hardly visible to the naked eye; yet all the stars, down to and including those of the sixth magnitude, are only about 5,000 in number, and that over the whole round of the celestial sphere. Since we can see but half the sky at any one time, and since as a rule the stars near the horizon are cut off by the intervening sky-line, the number really visible at any one time is only about 2,000.

Grouping the Stars

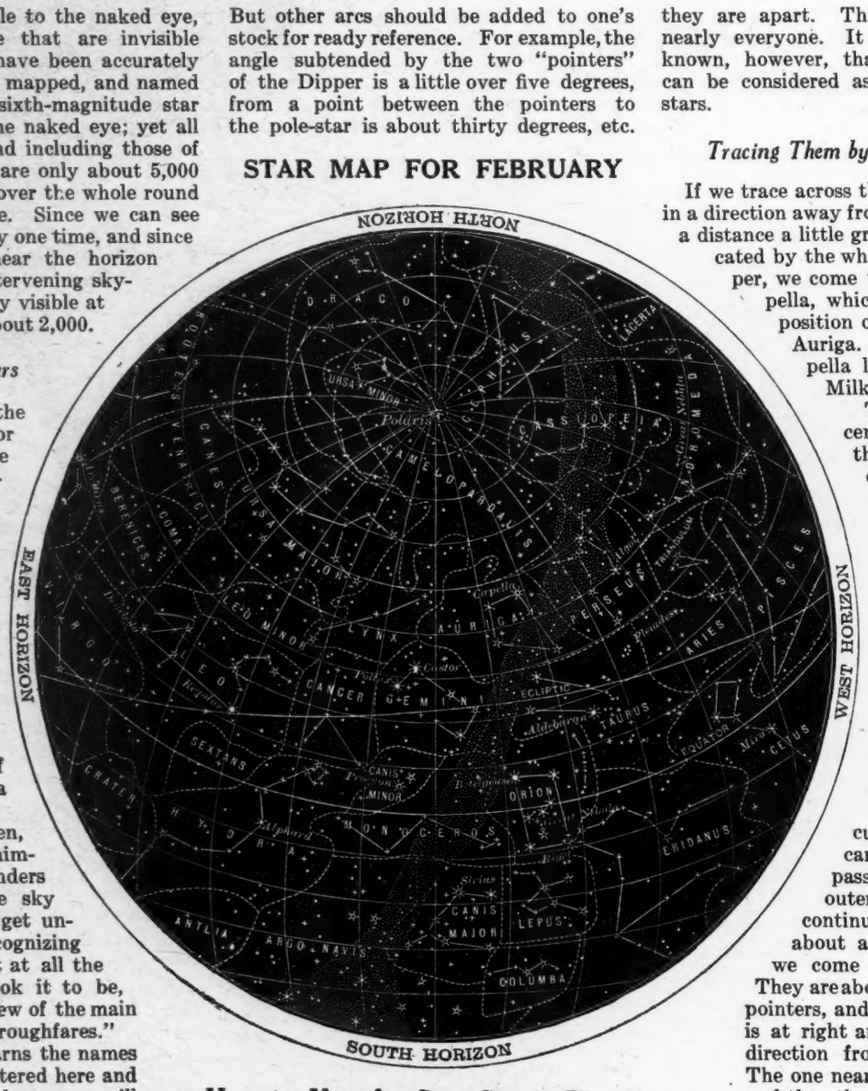
The dividing up of the stars into groups or constellations is quite arbitrary. Just because the stars are said to belong to the same constellation does not necessarily mean that they are in any way related. Their grouping has the advantage of enabling stars to be referred to readily, and of rendering the learning of the positions of the visible stars a simple task.

The stranger, then, who would sky-pilot himself among the wonders and beauties of the sky must "get out and get under" them, and, recognizing that the task is not at all the immense one he took it to be, begins to pick out a few of the main "signposts" and "thoroughfares."

The sooner he learns the names of a few groups, scattered here and there over the sky, the sooner will he have a network of "landmarks" or skymarks to refer to in locating the other smaller groups or isolated objects. In this article the Big Dipper will be considered in its relations to the visible star groups.

In the sky one does not go so many *blocks* in a given direction before becoming hopelessly tangled up in the policeman's instructions. Rather, they trace out a line so many degrees long. Nothing is less valuable than a description of a celestial phenomenon given by someone who says, "The meteor had a streamer four feet long." The proper description would have been that the streamer was as long as the arc between two known stars, or so many degrees in length. A span in the heavens as great as from the zenith to the horizon is, of course, 90°. But other arcs should be added to one's stock for ready reference. For example, the angle subtended by the two "pointers" of the Dipper is a little over five degrees, from a point between the pointers to the pole-star is about thirty degrees, etc.

STAR MAP FOR FEBRUARY



How to Use the Star Street Directory

This map represents the appearance of the sky as listed below. It is specifically arranged for the latitude of New York, 40°N., but is practicable for ten degrees on either side of this latitude. Use the map at the times indicated. Hold it over your head with the north horizon to the north.

January	5, midnight		February	17, 9	P.M.
"	12, 11:30	P.M.	"	25, 8:30	"
"	19, 11	"	March	5, 8	"
"	26, 10:30	"	"	13, 7:30	"
February	2, 10	"	"	21, 7	"
"	9, 9:30	"	"	29, 6:30	"

The magnitudes are indicated on the map by stars of various kinds as follows: 0, open center; 1, eight points; 2, six points; 3, five points; 4, four points; 5 is indicated by a single point.

All times expressed in Eastern Standard Time.

The Dipper consists of seven stars approximately located as shown in the diagram.

The two outer stars of the bowl always point to the pole-star, which lies about six times as far beyond the stars as they are apart. This fact is known to nearly everyone. It is not so generally known, however, that the Dipper stars can be considered as pointing out other stars.

Tracing Them by the Milky Way

If we trace across the top of the Dipper, in a direction away from the handle and for a distance a little greater than that indicated by the whole length of the Dipper, we come to a bright star—Capella, which serves to mark the position of the constellation of Auriga. Just beyond Capella lies a section of the Milky Way.

Tracing through the center of the bowl of the Dipper, and in a direction away from the pole, we come to the bright star Regulus. It is about as far away from the bowl as is Capella. Regulus forms the bottom star of the handle of the Sickle in the constellation of Leo. Just at present Saturn lies a little above and to the west of Regulus.

If we imagine the curve of the handle carried *forward*, and passing through the lower, outer star of the bowl, continued for a distance about as far as to Capella, we come to two bright stars. They are about as far apart as the pointers, and the line joining them is at right angles to the indicated direction from the Dipper stars. The one nearest Capella is Castor, and the other is Pollux. They are the twin stars of the constellation Gemini. Just at present Jupiter is quite near, a little below and to the west of them.

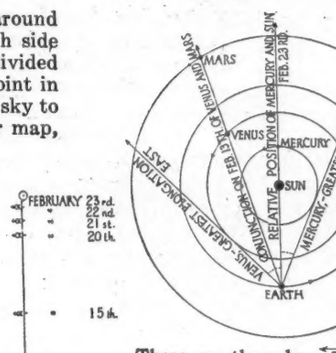
If we trace *back* the curve of the handle and continue the line for an arc a little greater than that subtended by the handle itself, we come to the bright star Arcturus, of the constellation Boötes. Those who wish to see Arcturus pointed out by the handle of the Dipper may do so by setting their alarm-clock for about 1 A. M. Finally, the constellation of Cassiopeia lies on the opposite side of the pole from the Big Dipper.

So, radiating out from our main guide-post, we find direction pointers to Auriga, Leo, Gemini, Boötes, and Cassiopeia, as well as to the pole-star. Having found these, the other stars and constellations can be picked out on the sky-map.

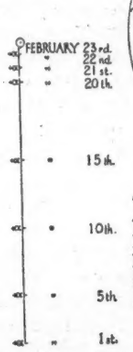
How to Find the February Planets

THE planet map shows a belt around the celestial sphere 40° on each side of the celestial equator. It is divided into halves so arranged that any point in either map is exactly opposite in the sky to a point exactly opposite in the other map, but as far above the equator as the first point was below, or *vice versa*. For example, compare the positions of the sun and the earth's "shadow" at different dates. The vertical lines are "hour" lines, and the space between two adjacent ones indicates the amount the earth turns us about beneath the stars above us in one hour. The hour lines are said to measure the Right Ascension of a star. Right Ascension is measured eastward.

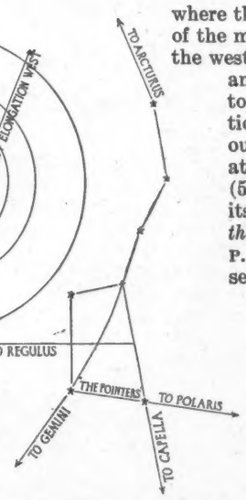
The lines marked "Eastern Horizon" and "Western Horizon" show how the horizon cuts the map for the latitude of New York at 6 P. M. on February 1. They are approximately the same for any point in the United States, southern Canada, or northern Mexico. They are drawn in for that hour to show how they are placed. To find their position at any other time proceed as follows:



These are the relative paths which Mercury, Venus, Earth, and Mars follow in their trip around the sun



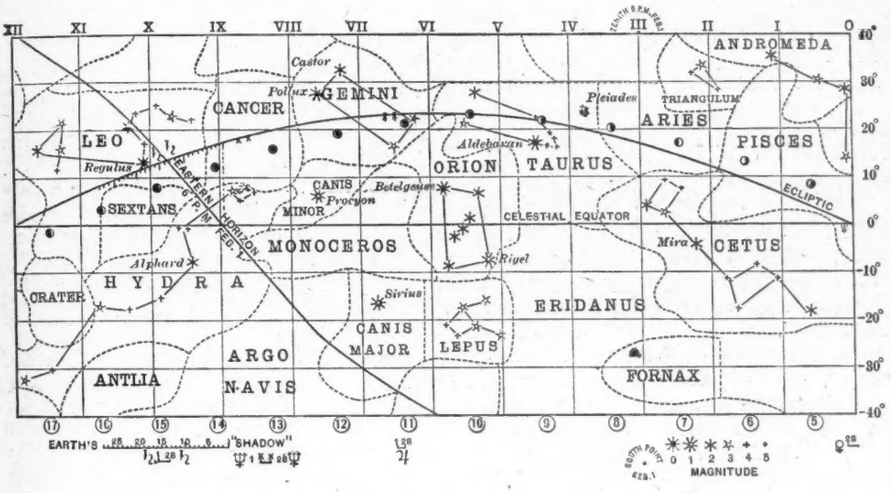
The separation in Right Ascension of Mercury and the Sun in February

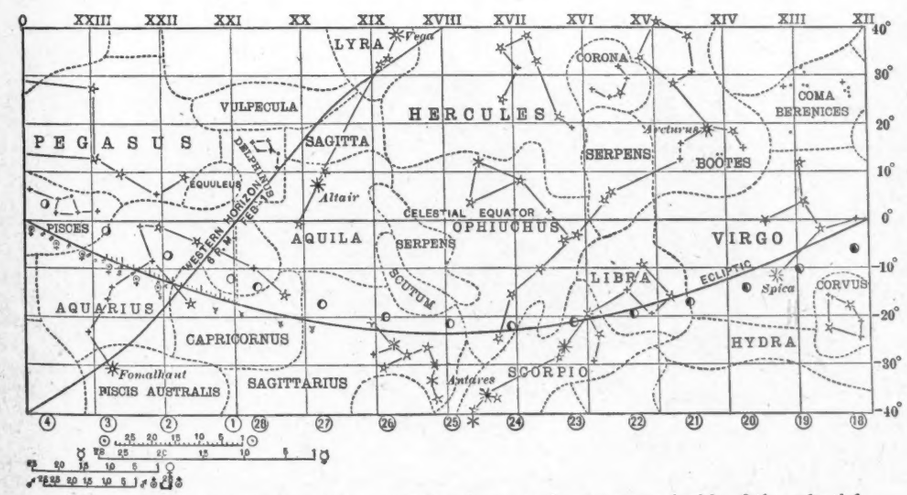


The Big Dipper is often used as reference in locating other constellations and stars

Cut two slips of paper having the curve of the *western* horizon on the *left-hand* edge of one, and that of the *eastern* horizon on the *right-hand* edge of the other. Mark where the equator and the top and bottom of the map meet this cut-out curve. Place the western horizon first. For 6 P. M. on any day, find the point on the equator immediately above the sun's position for that date, and place the cut-out edge so that it cuts the equator at that point. For one hour *earlier* (5 P. M.), slip the horizon parallel to itself an amount equal to one hour *to the right*, etc. For one hour later (7 P. M.) slip the horizon parallel to itself an amount equal to one hour *to the left*, etc. When this western horizon is once placed, the eastern is placed immediately opposite in the other half of the map. Then all the sky to the left of the western and to the right of the eastern horizons is visible at that time.

Mercury lies so close to the sun as to be scarcely ever seen. Venus, Mars, Jupiter, and Saturn can be seen as bright stars when properly placed with respect to the sun. Uranus and Neptune are too faint to be seen with the naked eye, but are visible in a small telescope. The moon positions are indicated by circles, the inked-in portions showing the illuminated part.





This map shows a belt around the celestial sphere, 40 degrees on each side of the celestial equator. The lower half is simply a continuation of the upper half. For proper illustration of how to use this map see page 78 of Popular Science Monthly for January

Planets for February

DURING this month Mercury and Venus are again found close to the sun. They are always so placed. Being nearer to the sun than is the earth, we must always look within the earth's orbit to see them. The diagram shows, too, that Mercury cannot wander as far from the sun as can Venus. When they reach the outer edge of their orbits as seen from the earth, they are said to have reached their greatest elongation east or west, as the case may be. The diagram indicates these positions for Venus and Mercury.

Mercury reached that point on January 7. It has since then been coming closer to the sun each day. If we compare their separation on successive days, we shall find they both have the same Right Ascension on February 23. They are then said to be in conjunction. Mercury is passing *behind* the sun at this time, so the conjunction is said to be *superior*. If it had been going in *front* of the sun, it would have been said to be in *inferior conjunction*. Since Mercury shines with the light from the sun, it is "full," as seen from the earth at superior conjunction. Being so close to the sun, however, it is not visible.

Venus and the moon are in conjunction, *i.e.*, have the same Right Ascension on the evening of February 1, Venus being about seven degrees below the moon. This will be a very pretty sight in the evening sky—the thin crescent moon and the bright planet.

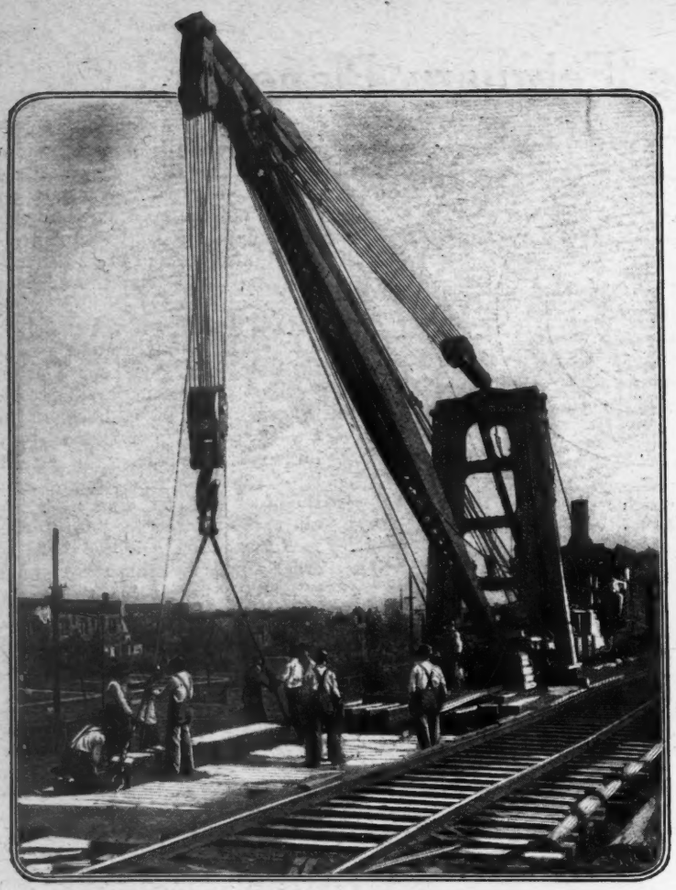
Mars is also an "evening star," and is a little east of Venus on February 1, but west of it and nearer the setting sun at the end of the month. Both have the same Right Ascension—are in conjunction—on the morning of the 13th, and the conjunction is very close, Mars being only about half a degree south of Venus. It will be a good opportunity to compare their colors. The darker one is Mars.

Jupiter and Saturn are still retrograding. Jupiter is in conjunction with the moon on the 10th.

Saturn is in opposition on the 14th, and a little later on the same day is in conjunction with the moon. That is, it is on the opposite side of the earth from the sun and close to the moon. So the moon is also in opposition, and consequently full. As it comes below the earth's "shadow," it is not eclipsed, nor does it eclipse the sun near the beginning of the month, as it is above it. New moon occurred January 31.

Uranus and Neptune are in same part of the sky as in January. The latter is retrograding. Their positions are marked with small crosses. The intersection of the cross marks the position of the planet. Neither is visible to the naked eye.

The moon's positions have been indicated by enlarged circles, and the visible portion inked-in to show the phase. We have already noted that it is new on the 31st of January (6 h. 7 m. P. M., E. S. T.), and that it is full on February 14 (6h. 38m. P. M., E. S. T.). It reaches first-quarter on February 7 (1h. 52m. P. M., E. S. T.), and last quarter on the 22d.



This powerful derrick can lift fifty tons much more easily than most people can lift a brick

A Special Truck Helps This Derrick to Juggle Huge Stones

HOW to help a powerful derrick pick from a flat-car a deck slab weighing 65,000 pounds, swing it deftly around in midair, and then gently lower it into its designated place as a part of a viaduct bridge, is a puzzle that has been solved in track elevation work in Chicago.

The handling of such loads is made possible through the use of a special truck of 150 tons capacity, placed directly under the massive A-frame, and through the use of powerful timbers blocked and wedged under the T-shaped head of the A-frame. From the rail to the top of the A-frame is nearly 30 feet. The immense strain of the load in hoisting is carried by a central steel tie or tension member, which is anchored to the deck framing of the car.

That the entire hoisting equipment is massive is indicated by the fact that the hoisting blocks used for this work each weigh from 2,000 to 2,600 pounds. There is a six-part tackle for the main hoist, with ⅞-in. wire rope in heavy steel blocks. A wire-rope sling handles the slabs. The ends of the sling are attached to stirrups embedded in the concrete, and the shackle is placed on the main hoisting-block.

A smaller boom, 50 feet long, hoists 25 tons on a reach of 35 feet, but with the larger 67½-foot boom a load of 50 tons can be handled on a reach of 30 feet. In moving the derrick the A-frame is laid back over the deck of the car, and the boom rests on a timber horse on a flat-car ahead of the derrick-car.

Turning a Locomotive into a Stationary Engine

ON big farms and plantations, in lumber-camps, mines, quarries, and in construction work on a large scale, narrow-gage locomotives of a small and comparatively light type are frequently used for transportation purposes. An invention recently patented by a citizen of Bogota, Colombia, provides means for using such locomotives in the place of stationary engines without making any change in their construction beyond placing a cog-wheel on the front axle of the engine.

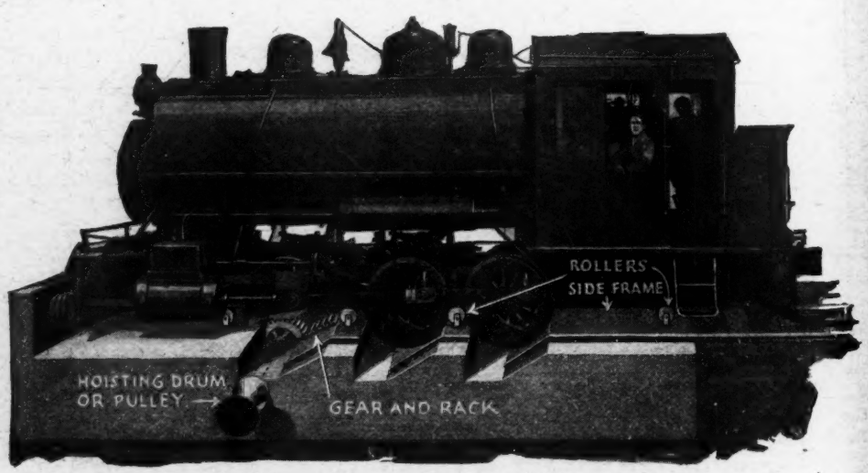
When the services of a stationary engine are required at any particular point, it is necessary simply to lay a spur track to that point, install at its end the adaptation device, and run one of these small locomotives in position.

The mechanism for transmitting the power of the locomotive is embodied in a structure placed at the end of the spur track. The structure comprises a base, which may be of concrete or metal. On this base are tracks which align with the tracks of the railroad and which end against an abutment provided with bumpers and a hooking device for holding the locomotive in place. There are two transverse recesses, corresponding with the front and rear wheels of the locomotive, in the base. The sides of these recesses, farthest from the bumpers, form inclines, and are also provided with rails aligned with the tracks. The gap farthest from the bumpers can be bridged with laterally movable rail sections. These sections are moved aside after the front wheels of the locomotive, approaching the bumpers to get in position, have crossed.

When the locomotive has reached the point at which both sets of wheels roll down the inclines of their respective recesses, the cog-wheel on the front axle engages the teeth of an inclined rack, which acts as a brake, preventing the too sudden descent of the wheels. When the wheels reach a point near the bottom of the incline, the side-frames of the locomotive come to rest upon rollers mounted on suitable bearings. The geared wheel on the front axle of the locomotive engages with the cogs of a stationary wheel mounted on a shaft which has at its end a pulley which transmits the power of the locomotive by means of a belt.

When it is desired to use the locomotive again for transportation purposes, the engine is reversed, the hook holding the locomotive against the bumpers thereby released, and the geared wheel on the front axle shifted from the transmitting gear to the inclined rack, by which the locomotive is raised up the inclines to the track level.

The laterally sliding rail section for closing the gap formerly occupied by the rear wheels is automatically moved in position, enabling the front wheels to cross the gap.



Any small locomotive can be changed into a stationary engine simply by placing a cog-wheel on the front axle

Raising a Sunken Whaleback from the Bottom of a Lake

OWING to the great demand for iron ore and grain during the war, the freighters on the Great Lakes were operated as far into the winter as possible.

A large fleet of boats was caught in the ice at the western end of Lake Erie, and a number of whaleback steamers and several tugs were employed to set them free. The whaleback *Henry Cort*, while crushing ice, collided with another steamer and was sunk.

When the owner looked for her in the spring in order to raise her, she could not be found. A reward of five hundred dollars for finding the boat was earned by a Lake Erie fisherman.

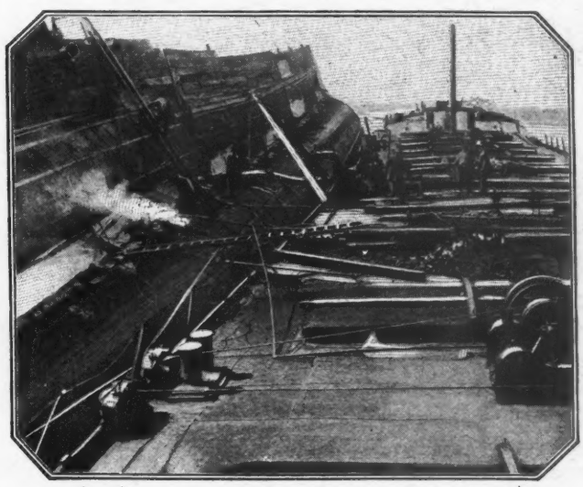
She had been carried more than six miles away, and lay in thirty feet of water. The hull had settled in the mud, and the ice had carried away her masts and superstructure. The task of raising the ship was much hindered by her being in the open lake, and the work was frequently interrupted by bad weather.

The first attempt to raise the *Cort* was a failure because her deck collapsed under the strain of pumping. Then a cofferdam 240 ft. long was built and screwed down to her hull by divers; but, owing to bad weather, the dam was wrecked twice before the boat could be pumped out. After several months a successful trial was made.

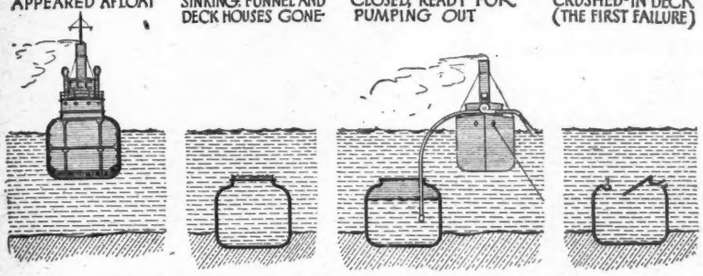
The cofferdam was strengthened, and additional pumps were brought into service; the dam was protected from the wind and waves by barges, one on each side of the structure, and a steamer was anchored so that she lay across the end that was exposed to the weather.

At last the sunken boat was brought to the surface, and her hull was found to be in good condition despite her long voyage on the bottom of Lake Erie.

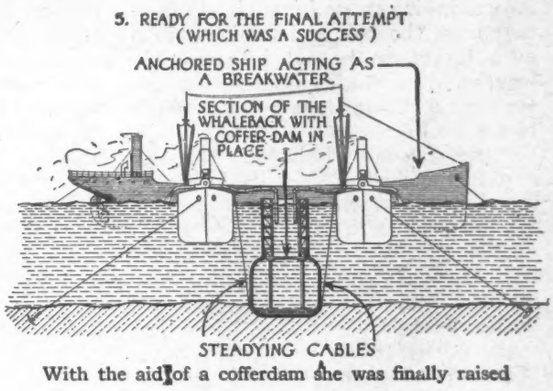
The *Henry Cort* has a carrying capacity of about 3600 tons.



Hull of the *Henry Cort* about to be towed into port



The first attempt to raise the ship was unsuccessful


5. READY FOR THE FINAL ATTEMPT (WHICH WAS A SUCCESS)
ANCHORED SHIP ACTING AS A BREAKWATER
SECTION OF THE WHALEBACK WITH COFFER-DAM IN PLACE
STEADYING CABLES

With the aid of a cofferdam she was finally raised

Pour in the Concrete and Take Out a Ship

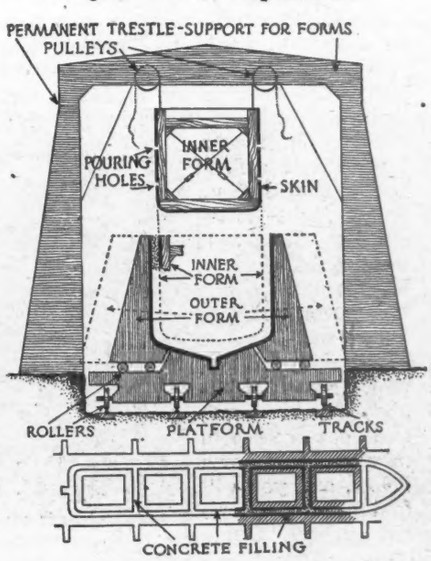
By F. W. Fitzpatrick

TO expedite the building of concrete ships and reduce their cost, I would suggest that the most serviceable types be standardized and permanent forms built.

I would suggest that a pit be dug, more than double the width of the ship to be built, and abutting on the water. From the water end of the pit, which should have a level bottom, an inclined plane would extend into the water. On the bottom of the pit a track should be laid, extending down the incline into the water. There should be a platform, double the width of the ship, resting on wheels or rollers.

The outer shell of the casting form I would make in three sections. The bottom part, including the keel, would be an integral part of the platform. The side forms would be in two sections, meeting at bow and stern-post.

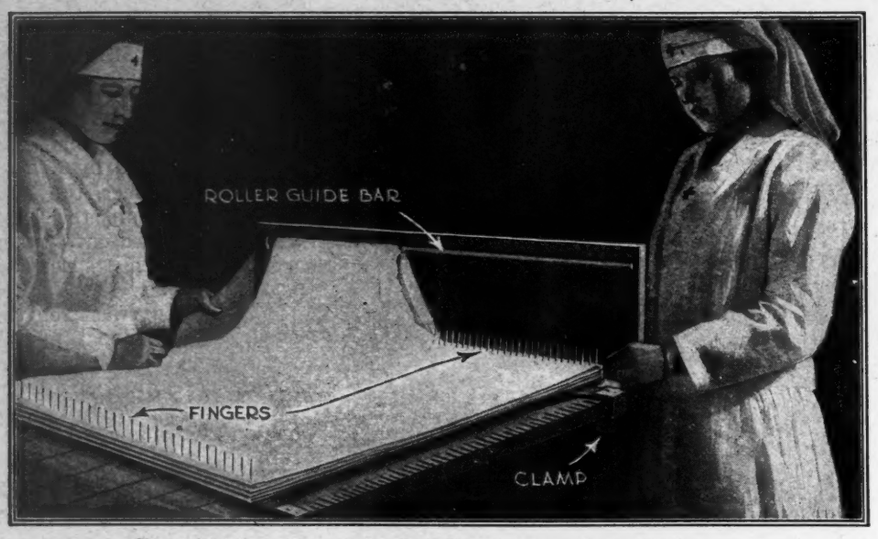
The inner core of the form I would make in one piece, which could be raised or lowered by means of chains or cables and pulleys.



With a sufficient number of movable forms, a hull could be turned out every few hours

To cast a ship, the two outer side forms are moved in position against the bottom form and properly braced. The metal reinforcements for the hull and the compartment walls are put in position, and then the inner form is lowered to its proper distance from the outer form. The concrete is poured into the form from the top and through openings provided in the inner form.

After the concrete has hardened, the inner form is lifted out of the hull by the raising mechanism, and the side forms are rolled back on the platform, to allow the hull to pass between them. Then the whole platform is lowered into the water by means of the inclined railway and the hull is launched. I suggest that a large number of such casting plants be built, to make it possible to turn out a ship every few hours.



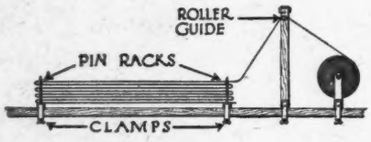
The faithful workers of the Red Cross are greatly assisted by this device in preparing bandages for wounded soldiers

A Mechanical Helper for the Red Cross

MILLIONS of bandages of different length and width are required in the hospitals for dressing wounds. Miss Lulu H. Miller, of Brooklyn, N. Y., has invented a device for unwinding gauze for surgical dressings from the bolt and folding it into even layers, to be cut into suitable lengths. She has patented her invention, and will donate the receipts to the Red Cross.

A substantially built table, about two feet wide and from eight to ten feet long, has marked along its longitudinal edges coinciding scales in inches and fractions of inches. Two strips of wood, equal in length to the width of the table, are provided each with a row of equidistant and sharp-pointed pins extending over their entire length. They have also at each end a clamp by means of which the strips can be securely fastened to the table. Another strip, also provided with clamps for fastening it to the table, has standards at its ends, which form the support of a roller or spindle, intended to guide the material as it unwinds from the bolt and is fed to the folding contrivance.

In operating the device, the gauze is unwound from the bolt or roll at one end of the table and drawn over the roller. Near the end of the gauze a thread is drawn to make sure that a straight start is made. The material is folded at the thread line, and fastened to the strip farthest from the feeder by pushing the folded part down on the pins. Then the material is stretched evenly to the other strip, which has been clamped to the table at a distance depending upon the desired length of the bandages. Then the material is folded, again allowing half an inch margin, and the fold, which must be square to the edge, is pushed down upon the pins. Then the material is drawn to the other strip, and the operation of measuring, folding, and fastening down the fold of the material is repeated. This is continued until the entire bolt has thus been folded between the pin-racks.

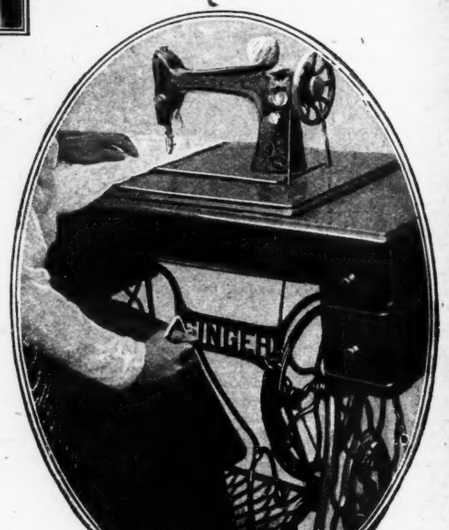


As the gauze is unwound from the roll it passes over the guide to the pin-racks, where it is folded, ready for cutting

No Legs Needed to Run This Sewing-Machine

MANY people barred from industry by loss of limbs, will ride back into active life on the tide of invention inspired by the thought of thousands of returning crippled soldiers.

One such invention, by James M. Jackson of Philadelphia, makes it possible for a person without feet or legs to operate a sewing-machine. It consists of a lever with a handle at one end and a stirrup-shaped fork at the other end. The two ends of the fork are fastened to the treadle, which may then be operated by rocking the lever back and forth by hand.



By pumping the handle of the lever, a person without legs may operate the treadle of this sewing-machine

It Does Everything but Cook Breakfast

IF you would like to spend most of your life in one spot, buy one of the complex chairs recently invented by Edwin J. Floyd of Douglas, Ga.

When all adjustments are tucked away, the chair is an ordinary one. Swing out a brace in the rear, and it becomes a rocker. Fasten it in a fixed position, and it no longer rocks—it reclines. Change it once again, and you have a flat, bedlike horizontal surface. When back in the original position, pull some wires above your head, and out comes a mirror. Dig down below, and you will find some convenient drawers. Swing up a broad leaf hinged to one arm, and you have a table or desk.

Suppose you start the day in one of these chairs. First you bring forth the mirror, get out a comb from one of the drawers, and comb your hair. Swing up the table and have your breakfast served on it. Then recline or rock while you read the morning paper. This done, sit up again and work (material found in the lower right-hand drawer). When tired of work, play solitaire or knit (lower left-hand drawer). And so on until night comes. Then flatten out the chair, turn over, and go to sleep.

This chair is equipped with a table, rockers — everything for comfort

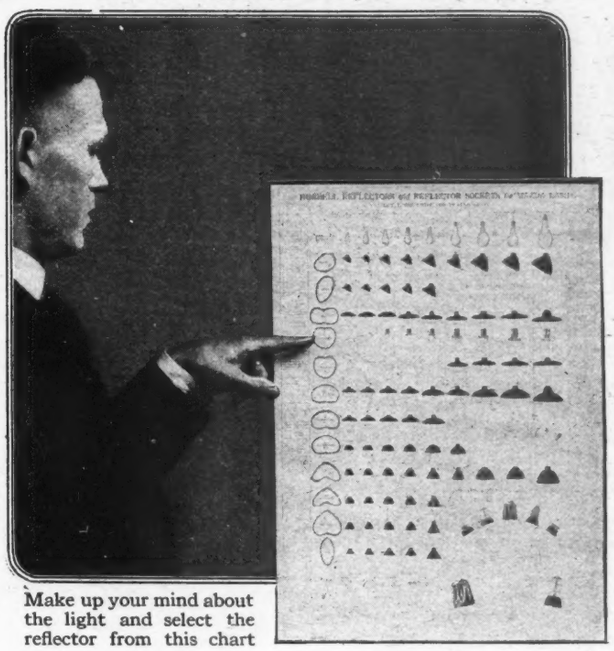
Look at the Chart and Pick Out the Reflector You Need

A GREAT deal more depends upon the reflector than the average user of electric lights realizes. The reflector not only determines the size and shape of the field of illumination, but in a large measure the character, concentration, or diffusion of the light.

The same lamp will give entirely different illuminating results with different reflectors, and it is a problem of efficiency for the user of electric lights to select for his lamps just the right kind of reflectors. The illuminating effect of electric lamps, and its modification by the reflector used, has recently been reduced to a science.

Charts have been worked out which indicate not only the size and shape of the illuminated field, and the rest of the data which it is essential to know for selecting the most effective light and reflector, but also present them in such simple and concise form that the purchaser who wishes to install electric lamps in his house or place of business can make his selection quickly, easily, and with every assurance of success.

A chart for this purpose, is shown in the accompanying picture. The illustrations on the chart are self-explanatory and the reading matter on both sides and underneath the illustrations contain additional data for the guidance of prospective users of electric lamps.



Make up your mind about the light and select the reflector from this chart

Does That Gold Watch of Yours Keep Good Time?

GOOD watches are expensive, but expensive watches are not always good. Let us suppose that, in buying a watch, you are not afraid of depleting your pocket-book, but feel some anxiety lest you may not get your money's worth in the shape of accurate time-keeping. This is where a paternal government steps in. You need only demand a Bureau of Standards certificate, and if the dealer can produce this document you may rest assured that you are getting an excellent timepiece.

The tests at the Bureau of Standards, in Washington, are made four times a year, beginning on the second Tuesday in January, April, August, and October. The more elaborate tests, known as Class A, require fifty-four days, while the simpler tests, known as Class B, require forty days. It is perhaps significant of the severity of these tests that not more than twenty or thirty watches are sent to the Bureau for testing each quarter.

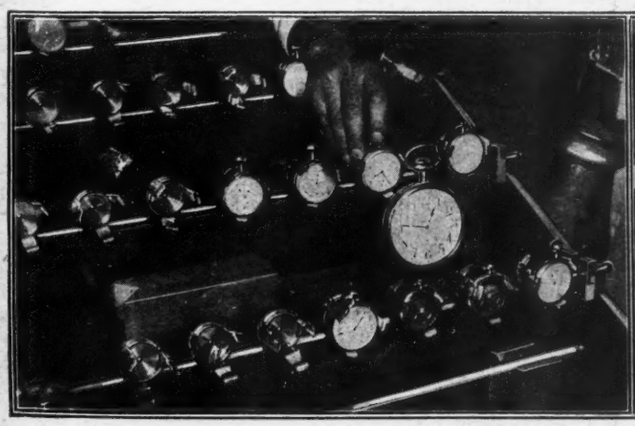
In the watch-testing room at this establishment the most conspicuous piece of furniture is an immense oak cabinet with a glass door. The cabinet is air-tight, and its temperature is kept uniform.

Watches are tested for position, isochronism (uniformity of rate in time-keeping), and temperature. Readings are made with a small telescope through the glass door of the cabinet.

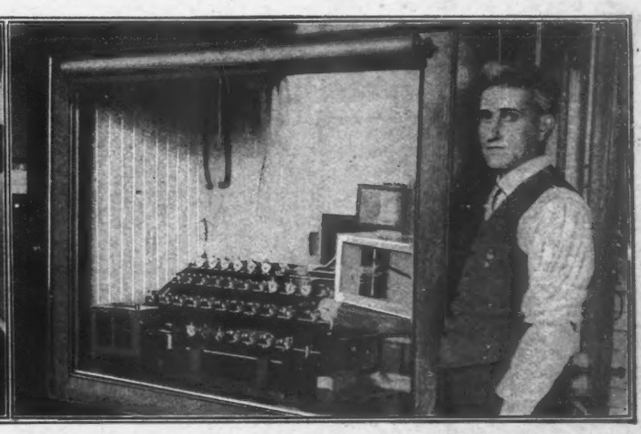
Sighting each watch in its turn, the expert taps a telegraph-key as the second-hand reaches the fifty-eighth, sixtieth and second mark on the dial. Each tap is registered on the sheet of a chronograph (recording clock), and this instrument is also made to register seconds by an electrical contact in a standard clock, regulated daily by the time signals of the Naval Observatory. Subsequent examination of the chronograph sheet shows the error of each watch, at the time of reading, within a tenth of a second.

In Class A the watches are tested in five positions: vertical with stem upright, turned to the right, and turned to the left, and horizontal with dial up and dial down. In Class B the right and left vertical positions are omitted. The readings are made onee a day.

The isochronism test consists of readings every three hours until the watch runs down. This shows how its rate varies according to the time since elapsed since winding.



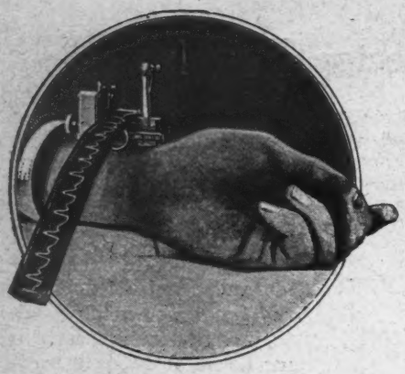
A chronograph registers the seconds of each watch as compared with the record of a standard clock



The cabinet through the glass door of which the time-pieces are tested; the cabinet is air-tight

The Measure of a Man

By Hinton Gilmore

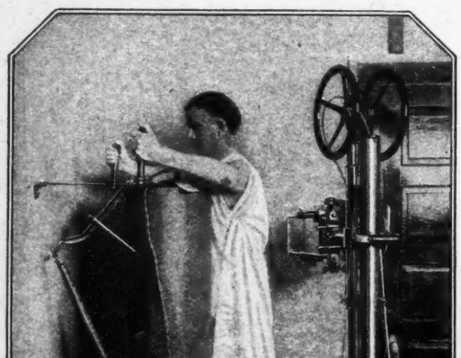


In the sphygmograph, the pulse-beat drives up a button on the device, and this motion is transmitted to a needle, which makes a tracing on a camphor-smoked film

MODERN advance in the science of diagnosis has made it possible to weigh and measure the vital organs and functions of the body with accuracy. The day of pulse-feeling, temperature-taking diagonosis is almost a thing of the past. Instead of submitting himself to a cursory checking over, the patient nowadays —especially if he goes to an up-to-date hospital or sanatorium—will be studied, calipered, and charted according to an elaborate system in which mechanics play an important part. Here is a list of alarmingly named instruments that are ready to lend their aid in the measuring of a man:

Microscope, chemical balance, polariscope, stethoscope, sphygmograph, sphygmomanometer, dynamometer, polygraph, electrocardiograph, respiration apparatus, hemostoscope, X-ray, gastroscope, proctoscope, cystoscope, laryngoscope, ophthalmoscope, thermometer, and esthesiometer.

And here are some of the distinct laboratories that collaborate in the study of a single case: chemical, bacteriological, urinary, blood, metabolism, fecal, X-ray, anthropometric.



Taking moving pictures of the stomach while it is at work. The patient stands against the cylindrical plate-holder and the X-ray is applied from the rear

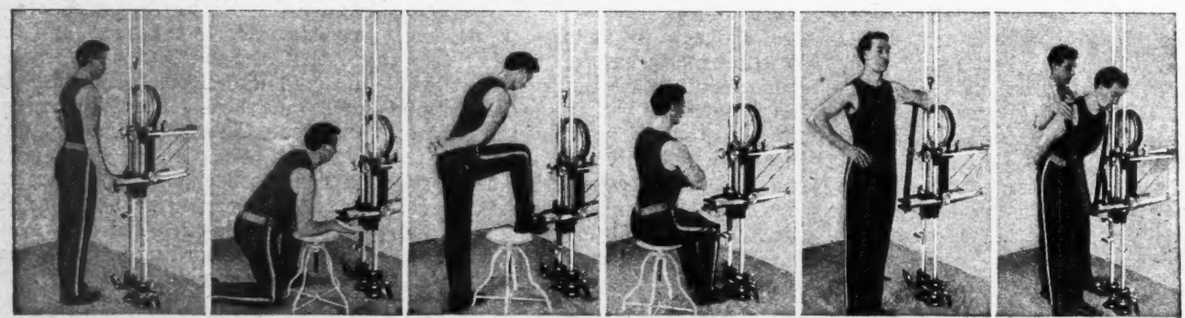
In the laboratories every important structure and function of the body is studied and compared with normal standards. Such an examination requires team-work. Half a score of experts, with their assistants, must contribute their special expert knowledge of fact and technique in working out the data necessary for a complete comparison of a sick man with a normal healthy man.

Hours of Expert Work

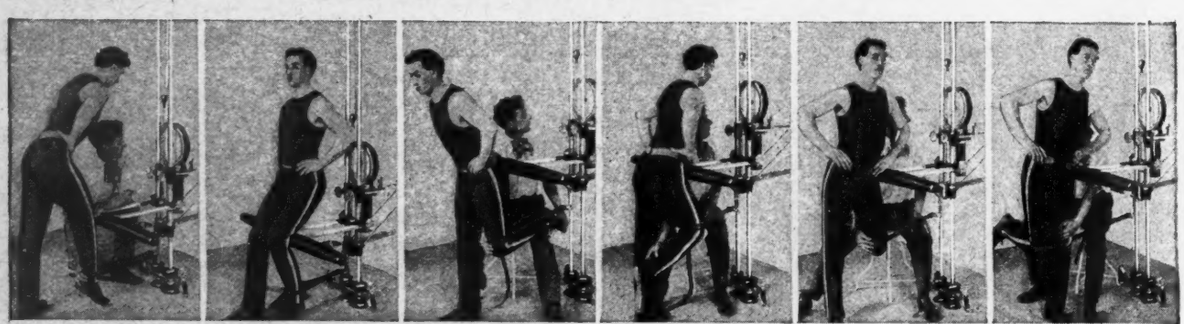
Such an examination requires, in the aggregate, many hours of careful concentrated attention and must necessarily occupy several days for its completion; but the information gained is invaluable.

The dynamic capacity of a man is measured by the dynamometer, a machine for testing every one of a set of muscles. Plotted on a strength graph, the results show the relation of the patient's strength to that of a normal man of the same height and weight.

If further data are desired, the actual horsepower of the patient may be determined by the eurostometer, or horsepower machine. This is a simple device in the operation of which the



Hand flexors · Hand extensors · Foot flexors · Foot extensors · Deltoid · Trunk Posterior



Leg flexors · Leg extensors · Thigh flexors · Thigh extensors · Thigh adductors · Thigh abductors

The dynamometer is a device by which it is possible to determine the strength of every important muscle or set of muscles. The machine is capable of making forty-five separate tests. To determine the strength of the individual undergoing the test, the capacity of the various sets of muscles is totaled in foot-pounds. The average man has a total strength of 4,500 pounds and the

patient exerts his strength against a resisting brake; the result is registered on a scale-beam marked in horsepower instead of pounds avoirdupois.

Lung power is readily demonstrated by the spirometer—simply a cylinder within a cylinder, the upper one being lifted by the air-pressure generated in vigorous exhalation. The lung capacity is registered on the beam as the cylinder is lifted.

Abnormal blood-pressure — one of the most significant functional changes in the body — is determined by a comparatively simple device. A rubber tubing is wrapped around the bared arm and inflated, so that the pressure of the blood is exerted against a tube of mercury. This registers the pressure of the blood with absolute precision. Such serious disorders as arteriosclerosis (hardening of the arteries), Bright's disease, and anemia are usually detected by the simple test.

The Electro-cardiograph

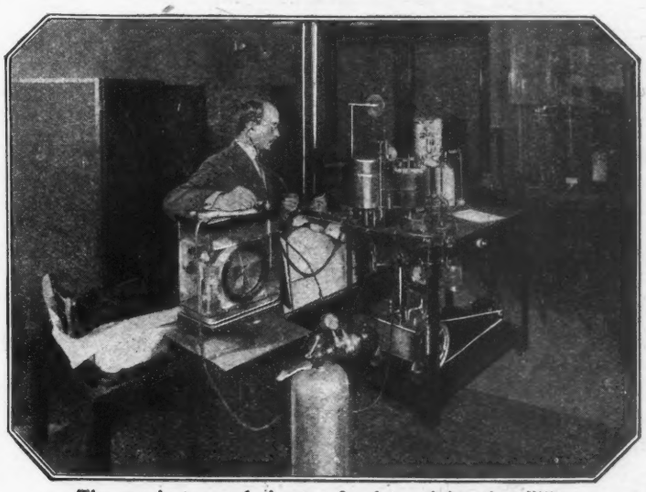
Abnormalities in the action of the pulse are made apparent by the sphygmograph—a mechanical apparatus through the operation of which exact tracings of the pulse are obtained.

The discovery that contractions of the heart are accompanied by the production of electrical currents has finally led to the perfection of apparatus by means of which information can be obtained respecting the morbid conditions of the heart, both organic and functional, which cannot be obtained in any other way.

This apparatus is known as the electro-cardiograph, and is not available except in the larger medical institutions throughout the country. Deviations of the heart action from the normal are registered in graphic form, and provide an accurate index to diseases of the heart.

The X-ray, of course, is invaluable in the study of pathologic conditions. It is especially important in observing conditions in the stomach and intestines. The patient first eats what is known as a test meal, in which bismuth, a harmless metal, has been mixed. This admixture renders the meal opaque to X-rays as it passes through the stomach and into the intestines. Ulcers of the stomach, intestinal kinks, adhesions, and the like may thus be definitely located.

Another important apparatus in diagnosis is the respiratory calorimeter. This is specially valuable in cases of suspected diabetes.



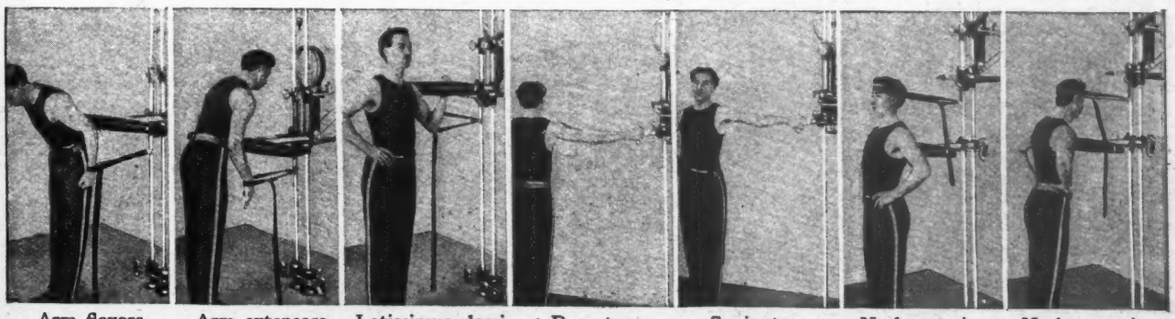
The respiratory calorimeter, for determining the ability of the body to assimilate food. The patient is connected to the machine by breathing-tubes. His supply of air comes from the machine, and his exhalations go back into it, passing into a container of soda-lime, which absorbs the carbon dioxide. By a comparison of the oxygen inhaled with the carbon dioxid exhaled it is possible to determine the progress of metabolism

Other Apparatus

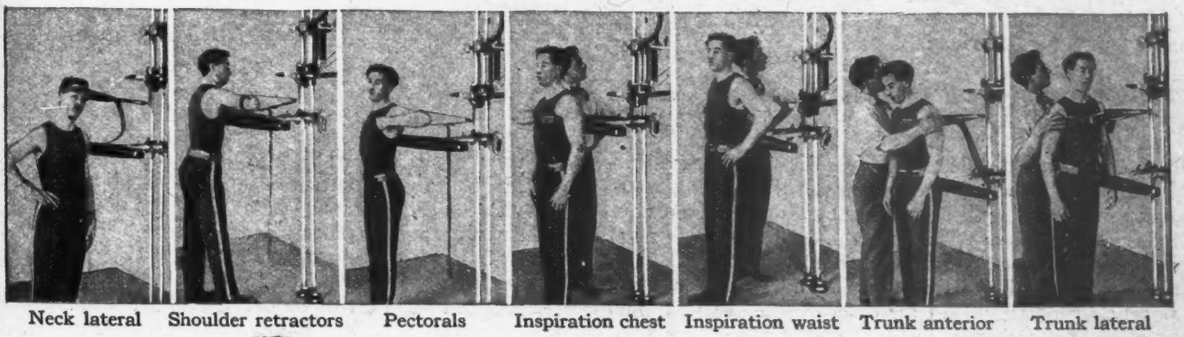
By means of the X-ray the presence or absence of stones in the kidney and of other diseased conditions of this organ may be determined. By means of the cystoscope the interior of the bladder may be inspected.

The gastroscope permits a visual examination of the interior of the stomach. This recently perfected instrument may render material service when other methods of examination prove ineffectual.

The bronchoscope not only permits an examination of the larynx, trachea, and lungs, but also facilitates the removal of foreign bodies.



Arm flexors | Arm extensors | Latissimus dorsi | Pronators | Supinators | Neck anterior | Neck posterior



Neck lateral | Shoulder retractors | Pectorals | Inspiration chest | Inspiration waist | Trunk anterior | Trunk lateral

average woman can develop 2,500 pounds. Under normal conditions the trunk-anterior test should register greater strength than any other muscles; but this is not always the case. The foot-extensor muscles, as shown by a series of tests made with the dynamometer, are usually the best developed in the average individual, owing to their constant use in walking

The Flying Mail's Big Debt to War

America again takes front rank in the air with machines of mighty power

By Carl Dienstbach

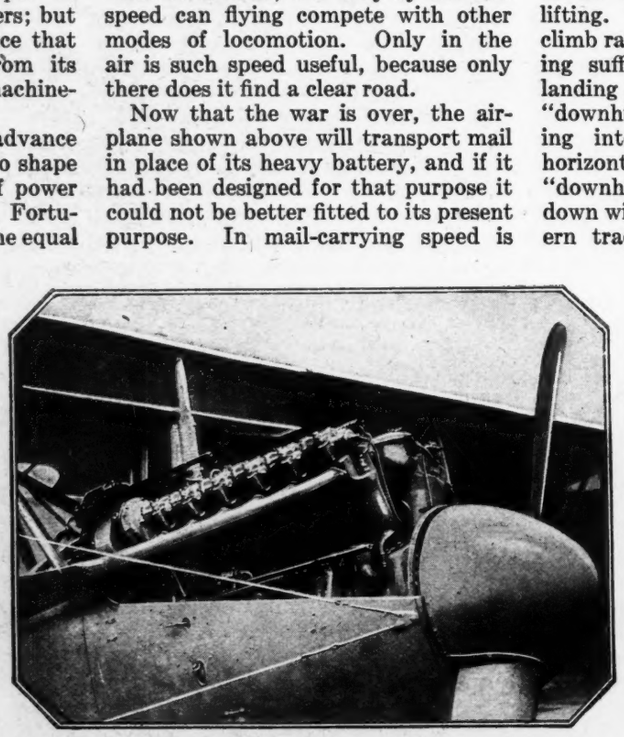
Built for war, this new American airplane will be used in the mail service. It represents the wonderful progress made by the science of flying in the past four years

THE accompanying pictures illustrate the representative result of what four years of war-stimulated progress have done for the flying-machine. It is the up-to-date representative of that medium-sized biplane with which the Wright Brothers inaugurated flight because it was inherently the most efficient type. It still has room for only two flyers; but that it has lift enough for twice that number becomes apparent from its formidable battery of eight machine-guns.

The essential mechanical advance is seen at a glance: the torpedo shape of the whole, and a display of power that suggests a locomotive. Fortunately, this machine, which is the equal if not the superior of the best in the world, is again as purely an American product as was the original Wright flyer. But the Wrights flew with 30 horsepower, while the biplane of to-day flies with 435!

The Liberty Motor

Yet this is one reason why Americans are again in the front rank of flying. It is in the big things that we excel. The watchlike finish required in smaller perfected motors of the highest grade was long unattainable under American conditions; and finally, at great expense, the French Hispano-Suiza motor was transplanted to this country.



The original Wright machine flew with 30 horsepower, while this Liberty motor roars out with 435. The engine, shown here at close range, was built for war, but finds use now in the air mail service

On the other hand, the big Liberty motor aimed at once at many hundreds of horsepower, and American ingenuity in designing won over labor conditions. The war's necessities for extreme speed and extreme lift, as required in the poorly supporting thin air of extreme altitudes and for very rapid climbing in emergencies, were responsible for the astounding increase of power from 30 to 435.

At first this would seem the height of extravagance in a machine devoted to any but military ends. But humanity is to be congratulated in that war development was, after all, identical with peace development. Only great reserve power (as required for war climbing) makes flying safe under adverse conditions; and only by extreme speed can flying compete with other modes of locomotion. Only in the air is such speed useful, because only there does it find a clear road.

Now that the war is over, the airplane shown above will transport mail in place of its heavy battery, and if it had been designed for that purpose it could not be better fitted to its present purpose. In mail-carrying speed is everything. The only concession to peace requirements should be the addition of a carbureting device to permit low-priced fuel of high heat value, such as crude oil, to be consumed. It seems by no means impossible, especially as the engine might be started and warmed up with gasoline.

The extreme torpedo shape of the airplane is the natural outcome of extreme power and speed.

Such extreme speed could formerly have been attained only if (by reducing wing surface and camber) the landing speed were likewise raised to a dangerous degree. But now it is different. Together with the greatest power, machines are also given plenty of wing surface and an ample camber of the wings, making the wings very lifting. As this would make them climb rapidly at top speed (while insuring sufficient support at a low, safe landing speed), they are simply driven "downhill"—thus transforming climbing into horizontal motion—to fly horizontally at top speed. Driving "downhill" would seem like pulling down with the propeller. But the modern tractor propeller in front sends its slip-stream against the planes, and that slip-stream acquires a lifting component at the same rate that the propeller pulls downward.

A Seeming Contradiction

In the machine shown the radiator in the slip-stream directly under the upper wing seems a surprising contradiction to the "torpedo shape" of the whole. It especially seems to ruin the lift or that portion of the lower surface of the upper plane which is directly behind it, and of the corresponding upper surface of the lower plane. But the lift of the lower surface is at least less than one-fourth of that of the upper one. And under the radiator there *is* no upper surface of a bottom plane but a fuselage. Also a radiator could not be placed in a better position for maximum cooling than into the strongest part of the slip-stream. Hence it is ridiculously small for 435 horsepower, and saves further resistance by being unusually deep. The tremendous fan effect makes its long channels cooling enough.

Biggest of Finished Girders Go Traveling

Six giants of seventy tons and two small brothers gave engineers a hard nut to crack

By John Walker Harrington

THE biggest ready-made girders in the world have been placed in the Park Avenue Viaduct, in New York City, after strange and costly transportation stunts on rail, river, and road.

Six giants of the series weigh 70 tons each, and are 137 feet long and 16½ feet high at the largest point. Two smaller ones would tip the scales at 58 tons, and are 107 feet in length. All are awkward in size, for they are double cantilevers, shaped to rest on columns of unequal length. Their jig-saw puzzle forms will be masked by granite masonry piers by the time the $600,000 viaduct is open for traffic next spring. Then automobiles will be coursing over a fine elevated driveway which will slope up gradually from Fourth Avenue and Thirty-second Street to the second story of the Grand Central Station at Forty-second Street and branch around the great terminal on either side to Park Avenue again.

There are longer and heavier girders than these in the world, but the sextette of 137-footers are, as far as engineers know, the largest ever fabricated at the mills and shipped all ready for installation.

They could not be transported in the knock-down forms, because there was no room anywhere in Park Avenue for assembling them, and because the whole area from Fortieth to Forty-second Street, which the metal work of the structure traverses, is honeycombed with tunnels and subways. The contractors therefore decided that it would be just as cheap to hire a special train and haul the cantilevers.

No heavier passengers ever traveled on a special than the steel octette which was placed aboard the long line of platform cars that pulled out of Phoenixville, in southeastern Pennsylvania, one Wednesday morning. The train had to be specially routed to avoid bridges that were not high enough to escape brushing the upper spans of the girders. It arrived at Greenville, N. J., on a Saturday night.

At the New Jersey water-front, the biggest marine derrick in the world enabled the Merritt Chapman Company to put each girder giant on a car-float. The double cantilevers were landed at the foot of Nineteenth Street, East River, and loaded on ponderous trucks, each of which was drawn by fifty-four horses.

When the huge girders were being conveyed, there was only one ramp from Thirty-second Street leading to Park Avenue. When there was a brief pause on the slope, a small donkey-engine to which a steel cable was applied helped the horses.

The girders for the right side of the viaduct were transferred after they were unloaded by means of rollers.

A derrick is shown here hoisting the last cantilever into position. This is the largest ready-made girder in the world

Preparing to swing one of the double-cantilever girders for the Park Avenue Viaduct to the north by block and tackle. The fifty-four horses that drew the beam have been unhitched. The 137-foot girder is loaded on a truck that weighs twelve tons

Turning the pole and front wheels of the giant truck with a block and tackle. The eight horses pulling it are equivalent to forty-eight because of the fact that the rope, by passing through the block six times, sextuples the power of the traction

Fifty-four horses pulling a seventy-ton girder swung to a twelve-ton reach truck—a dead weight of eighty-two tons

They are on their way to the Park Avenue Viaduct site, where the enormous cantilever girder is to be installed

Ships that Mother Seaplanes

Craft of the "Hush-Hush" fleet may play a part in first trans-Atlantic flight

© International Film

One of the most up-to-date seaplane mothers, *H. M. S. Furious*, of the British navy. Note the flush deck and the tunnel at the stern

THE wind was rising to half a gale, and the pilot of the seaplane felt that it was time to call it a day. "Let's go home to mother," he said to his observer, and set the flying-boat's nose in the direction of the English Channel.

An interval of swift flight, and the observer shouted: "There's mother now!" The seaplane's nose dipped down, and in a long, graceful curve she swung down to the water.

Surrounded by Secrecy

"Mother's" picture appears at the top of this page, and that of another mother to a seaplane brood at the bottom. They were known in navy slang as "Hush-Hush" ships, because of the great secrecy maintained about them while the war was on.

Although credit is given to the Italian and British navies for developing these mother ships, it was our own navy that first succeeded in launching an airplane from shipboard. Long before the war, a slanting runway was built above the forward deck of a warship, and a skilful flyer, starting his plane at the top, soared off.

Another daredevil later succeeded in landing safely on a similar narrow platform; but, even with a broad airplane deck provided, such circus stunts are not encouraged. To land safely on so small a space needs the extreme of nice judgment plus luck.

When the war saw the seaplane brood increase to large numbers, the British and Italians improvised mother ships from old liners by providing accommodations for hangars and installing special cranes to pick up and lower the planes. Later, craft designed for this particular purpose were built, of which the *Furious*, shown above, is the last word. Her flush upper deck, of unusual width, gives the airplane pilot plenty of chance to taxi off at the start, since the modern seaplane has wheels as well as pontoons. Under the deck are the hangars, reached through the tunnel-like opening at the stern. The large traveling crane forward picks up homing planes from the water, and swings them into the tunnel or lifts them out of their nests to the deck, ready for flight.

Although somewhat smaller than the latest "mother" ships, *H. M. S. Argus* also provided comfort for airplanes

Mother Ships in Peace

Perhaps the mother ships will play an important part in the first trans-Atlantic airplane flight. Believers in the seaplane as the type of aircraft most likely to succeed in that feat point out that mother ships stationed at intervals along the ocean track would reduce the element of danger to a minimum. Seaplanes suffering from engine trouble, or buffeted beyond endurance by storms while in mid-ocean, could find safe haven and continue their flight; an airplane once committed to the venture would have to go on or go down.

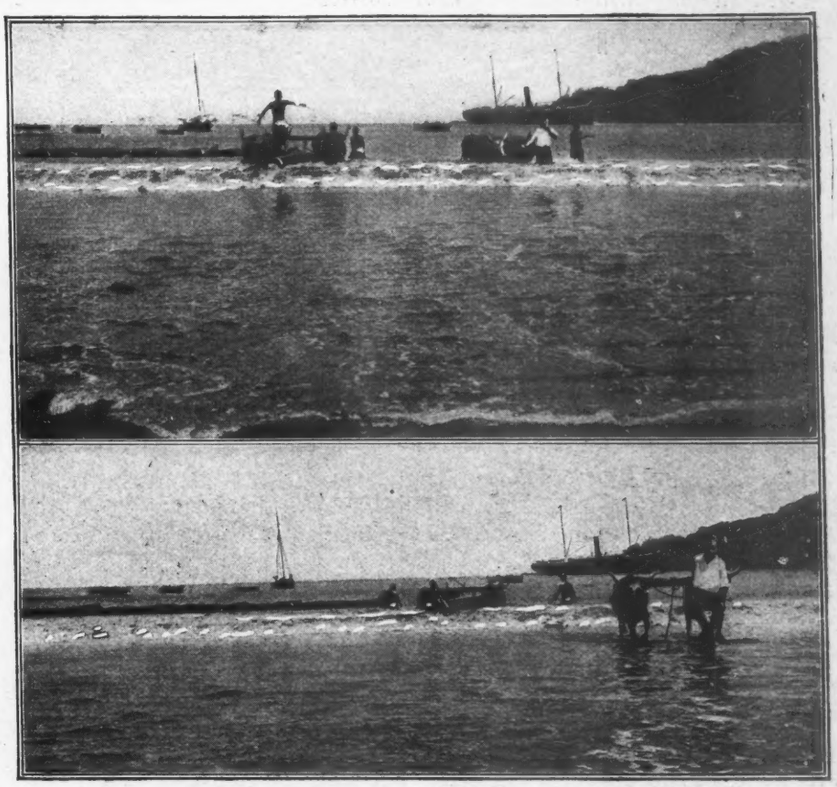
The difficulties of making long non-stop flights is illustrated by the numerous failures attending the attempt to inaugurate an airplane mail service between Chicago and the East.

Not only were the first aviators to make the attempts forced down, but their machines were unable to continue the flight and the service had to be temporarily abandoned.

Logging with Oxen through the Surf at Costa Rica

ACCORDING to forestry experts, modern methods of handling timber must supplant those of the most primitive sort before the hundreds of species of valuable woods that are to be found in the forests of South America can be appreciated.

The accompanying photographs, which were taken at Punta Arenas, Costa Rica, fittingly illustrate some of these primitive methods. Ponderous ox-carts, with wheels fashioned from solid slabs of wood, are used to transport the logs from the forests where they are cut to the harbors where they are loaded on ships. At the water's edge they are dumped from the carts and hauled out beyond the breakers,



In South America, clumsy ox-carts, with wheels of solid wood, carry valuable woods from the forests to the harbors. Here they are hauled out beyond the breakers and assembled into rafts

Frequently, in his struggles to start a log, the ox loses his balance. This one nearly lost his life when the tide broke over him

a distance of perhaps a hundred yards or more, and assembled into rafts.

Each log is hauled out separately by a yoke of oxen. Even on days when the sea is comparatively smooth, the oxen often are knocked down by the breakers, and quick work on the part of their driver is necessary to prevent them from being drowned. On days when the sea is rough, the loading of the logs must be entirely abandoned.

Practically all of the timber is in a green, unseasoned state, and will not float. Few of the kinds of timber brought out from the forests will float even when well seasoned. This means that the logs must be dragged on the bottom until the point where the raft is being assembled is reached. Here the green timber is lashed to logs of light, buoyant woods, and in this way a raft is formed that can be towed out to the ship's side.

Shipments of woods from South American countries are confined mostly to rosewood, mahogany, cedrela (Spanish cedar), and various dye-woods. This represents only about one per cent of the many valuable species of woods afforded by the timber resources of these countries.

The tropical forests of South America are vastly different from those to be found in the temperate regions of North America. In a single acre of ground it is not uncommon to find a score of valuable species. Yet only a few of these species are utilized.

Not until a large percentage of the timber of merchantable size is utilized can modern timber-handling devices be used in the South American forests. The method of cutting a tree here and there, ignoring hundred of others, prevents the introduction of modern labor-saving appliances.

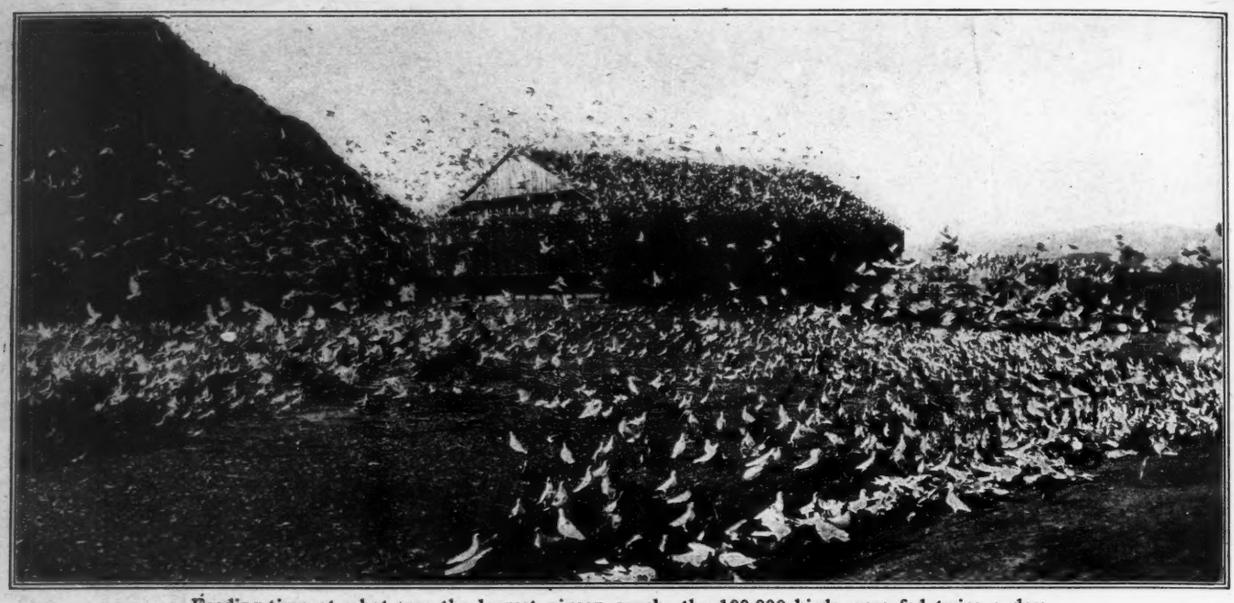
He Killed It with His Bow and Arrow

IN this day of the high-powered magazine rifle, it is more than a little interesting to find a man who goes hunting bear with a weapon older than history—the bow. Dr. Saxton Pope, chief surgeon at the San Francisco Emergency Hospital, is that man. The picture shows him with Arthur Young, another enthusiastic archer, just after the great triumph of their careers as bowmen.

It had long been Dr. Pope's ambition to kill a bear with his primitive weapon. His chance came when he caught a full grown black bear pilfering a bee tree. Dr. Pope and Mr. Young opened fire at thirty yards, and knocked the bear out of the tree. The beast rushed savagely at the doctor, who stood his ground and met the charge with steel-tipped arrows. The bear crumpled after receiving a couple of well directed shafts launched with all the force of a bow that has seventy-five pounds' pull.

© International Film

They hunt with the weapon used by primitive man, and it still seems to be effective



Feeding-time at what was the largest pigeon ranch; the 100,000 birds were fed twice a day

Ruthless Nature and Her Slaughters

ALL of the family were not at home when the picture was taken, but even so there are present a fair representation of the inhabitants of what was the largest pigeon ranch in the world.

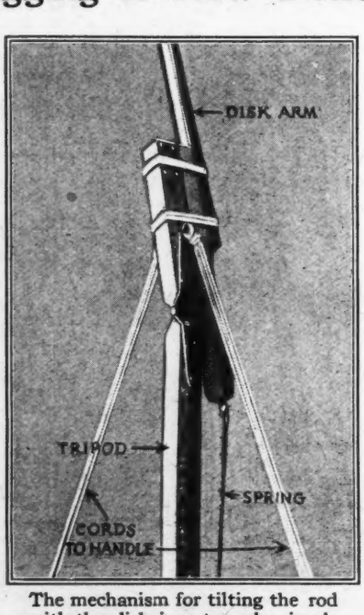
The ranch, spreading over about an acre of ground, occupied the edge of a pleasant valley on the outskirts of Los Angeles. Its owner had found squab-raising profitable, and estimated his bird "herd" at more than 100,000 adults and some odd thousand of babies. The soaring price of grain put many of the pigeon-raisers out of business, but the biggest ranch of all was destroyed in a manner that was much more effectual.

One night the Los Angeles River connected with a flood in the mountains, and led that flood right through the middle of the pigeon ranch. When the water had subsided the ranch buildings were somewhere in the Pacific, and where had once been the birds' feeding-ground was nothing but a hole in the river-bed, over which the stream has been flowing ever since that time.

Tens of thousands of the birds were drowned. The few survivors hovered about their former home for weeks—some of them for months; but they could not be brought together as a family again, and finally they scattered.

Wigwagging Is Now Done by Machine

IN the signal service of the American army the American Morse code is used, and for short distances the signals are given by two flags operated by hand. Semaphore signals, as these flag signals are officially called, are used when telegraph, telephone, or wireless lines are not available. The reasons are obvious. Even in good light and a clear atmosphere, flag signals cannot be read distinctly beyond a distance of 2,000 feet. Haze or fog will obscure them even at shorter range. Moreover, semaphore signals are slow. To manipulate two flags rapidly requires considerable effort and is extremely tiresome.



The mechanism for tilting the rod with the disk is extremely simple

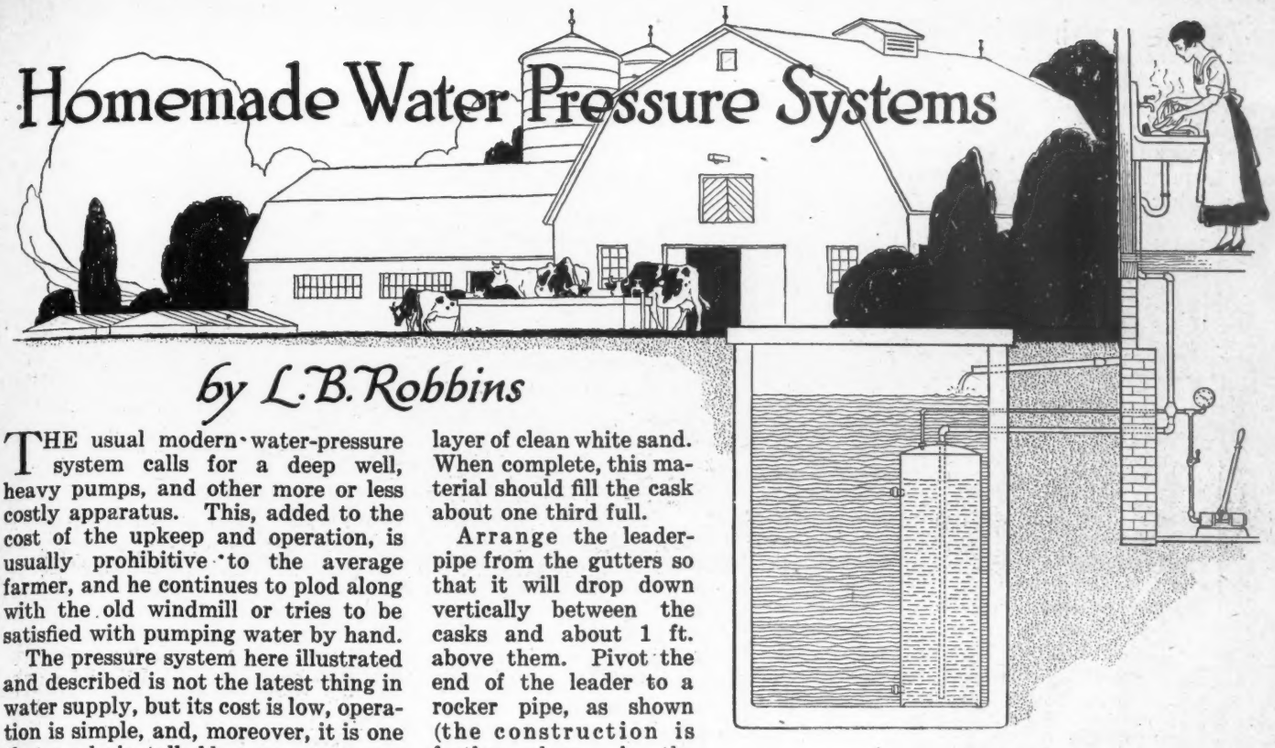
Swinging the disk to the right means a dot of the Morse code

A dash is indicated by swinging the disk to the left of operator

Lieutenant-Colonel B. O. Lenoir, of the U. S. A. Signal Corps, overcomes these disadvantages by signaling with disks. He uses a single disk in place of the two flags, and signals the dots or dashes by swinging the disk to one side or the other. The disks consist of wire hoops covered on one side with black and on the other with white cloth. The size depends upon the distance to which the signals are to be sent.

The disk, which is attached rigidly to a light rod about thirty inches long, may be operated by hand or, more efficiently, by a device designed by Lieutenant-Colonel Lenoir. To the top of a substantial upright post, braced by a sort of tripod, is hinged the rod with the disk, so that it may be swung in a vertical plane at a right angle to the line of vision. The disk is tilted by two cords attached to hinged tillers moved by hand.

Homemade Water Pressure Systems



by L. B. Robbins

THE usual modern water-pressure system calls for a deep well, heavy pumps, and other more or less costly apparatus. This, added to the cost of the upkeep and operation, is usually prohibitive to the average farmer, and he continues to plod along with the old windmill or tries to be satisfied with pumping water by hand.

The pressure system here illustrated and described is not the latest thing in water supply, but its cost is low, operation is simple, and, moreover, it is one that can be installed by anyone possessing only a meager knowledge of tools.

A well is not necessary; neither are pumps or a running stream. The only essentials are a simple, old-fashioned cistern, an old but tight water-boiler, and some good piping.

Its Three Parts

The outfit consists of three parts: the filtering system, to insure cleanliness; the pressure-tank; and the apparatus for generating the pressure. The method of filtering and how to procure good, clean water are shown in Fig. 1.

Two solid casks are set upon a platform, about 18 in. apart, as illustrated. Thread a close nipple or a short length of 1-in. pipe, and run it into a hole near the bottom of each cask and opposite each other. Give each cask a good coat of paint inside and out, using asphaltum. When dry, proceed to fill the bottom of each cask with filtering material. First put in a layer of loose stones about the size of an egg, then a layer of coarse gravel, and last a layer of clean white sand. When complete, this material should fill the cask about one third full.

Arrange the leader-pipe from the gutters so that it will drop down vertically between the casks and about 1 ft. above them. Pivot the end of the leader to a rocker pipe, as shown (the construction is further shown in the detail Fig. 3). The tee opening should be considerably larger than the inserted end of the leader pipe, so that the rocker can swing through a small arc each way before touching the sides. Pivot with a steel pin secured by washers and other pins. Provide the ends of the rocker pipe with elbows pointing downward to prevent wasting and splashing of the water. Any tinsmith will make up this rocker pipe at a small cost.

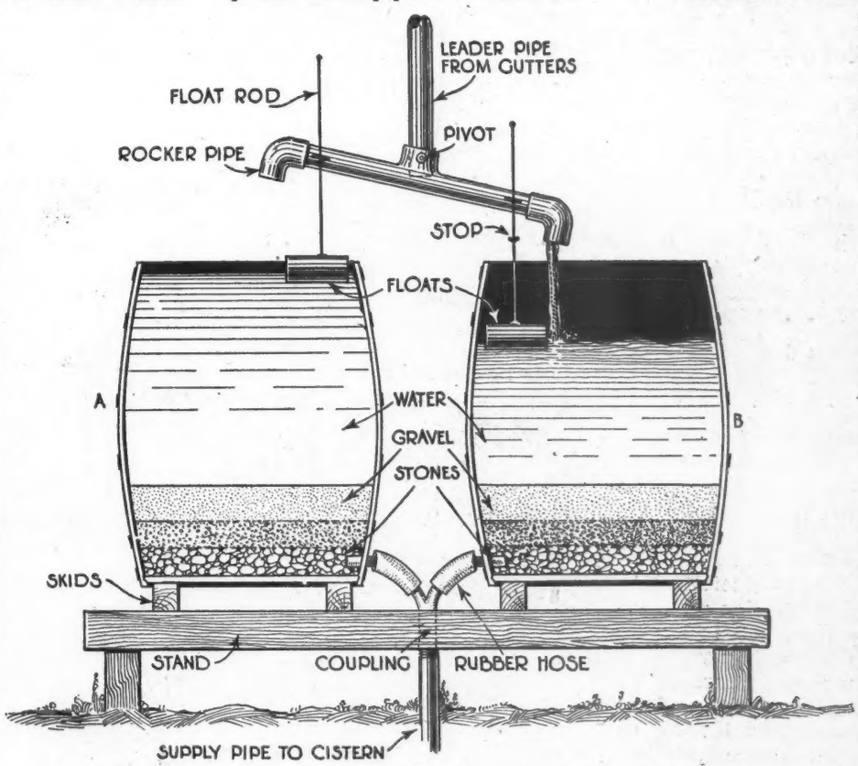


Fig. 1. To filter the water, two barrels are placed on a stand and the house drain-pipe run to the center between them, where a rocking pipe is attached

Now construct a pair of floats from tin cans, as shown in detail. A vertical iron rod should be attached to each float, and lead through an eye soldered to the side of each end of the water-pipe. A stop on the rod will bear against the eye, pressing that end of the rocker up when this particular cask is filled. The operation will be understood by studying Fig. 1.

Connect the outlets of the casks to a Y-coupling by heavy rubber hose. This is to lead the water from each cask to a main into the cistern.

To Make Connection

The method of installing the pressure-tank and connecting it with the air-pump and house piping is shown in Fig. 2.

The tank itself is composed of a common water-boiler as large as can be conveniently installed in the cistern. If it can be lowered to the bottom of the cistern, so much the better; otherwise stand it vertically, as shown, at one side.

Attach the main water-pipe to the house so that it enters the tank at the

top, the lower end coming within about ½ in. of the bottom of the tank. Fit this end of the pipe with a strainer. Lead the pipe underground deeply enough to prevent freezing, and place a check valve in the line, to prevent water from running back into the tank. Tap another ¼-in. pipe into the top

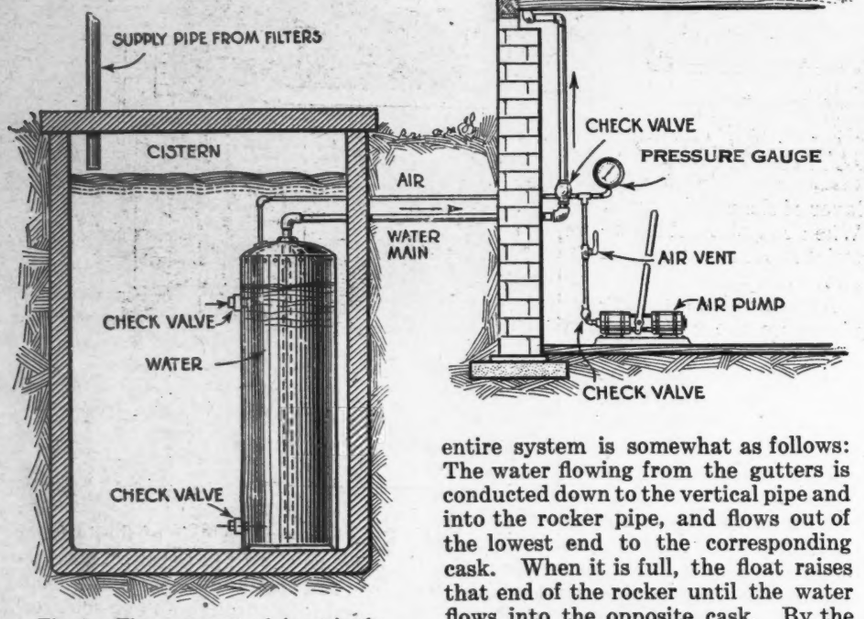


Fig. 2. The pressure tank is set in the cistern or well below the water level

of the tank, and connect it with an air-compressor placed conveniently in the basement of the house. At some point in the air line place an air-pressure gage that will register as high as 50 lb., and between it and the air-compressor fit a relief cock that can be opened to withdraw pressure from the tank. Near the compressor insert an air-tight check-valve. This will retain the pressure when pumping.

How the System Works

The tank should be fitted near the top and bottom with two heavy check-valves with their flaps swinging inward. These will allow the water to enter the tank, but will prevent it from flowing out when pressure is applied. Two valves will facilitate more rapid filling when the cistern is full. Under ordinary circumstances a hand air-compressor may be utilized; but if the farm-house has electric power, an arrangement like that shown in Fig. 3 may be used.

Connect the air-pipe to a small air-compressor operated by a motor of ample power. Extend the pipe out a little way from the gage, and to the end attach a diaphragm pressure-valve such as steam-fitters use. Arrange this so that it will operate at the required pressure. Attach a single knife switch, so that when the required pressure has been reached the diaphragm will force the stem of the valve outward in such a way that it will press against the short end of the switch arm and break the connection at the other end, thus opening the circuit and stopping the motor. This can be arranged with a double-switch system of control, as diagramed.

The operation of the entire system is somewhat as follows: The water flowing from the gutters is conducted down to the vertical pipe and into the rocker pipe, and flows out of the lowest end to the corresponding cask. When it is full, the float raises that end of the rocker until the water flows into the opposite cask. By the time that cask is filled the first is filtered dry, and the operation is repeated. Thus the cistern is filled with clean water.

The water-pressure in the cistern fills the tank through the check-valves and to within a short distance of the top; this space, being filled with air, prevents the water occupying the entire capacity. Air is now pumped in by hand or power until the maximum pressure is reached to force water through the pipes in the house. As the water goes down in the tank the pressure lowers accordingly, but can be renewed at will until the tank needs refilling with water. When this point is reached, release the remaining air-pressure by means of the relief-cock in the air line. This will allow the tank to refill with water.

A tank of 50 or 60 gallons' capacity should supply an average family with water for a day. With the hand air-compressor it takes only a few minutes to bring the water under the required pressure, and, with the electric arrangement mentioned, it is necessary simply to throw on the switch and let it pump until the diaphragm-valve automatically shuts off the motor.

A Good Lacquer Finish on Metal Articles

In the production of inexpensive manufactured articles, a lacquer finish is commonly used. People engaged in this work will tell you that there is a different finish obtained on castings and sheet-metal work, although each may be similarly treated. The finish on sheet-metal parts is even all over, but on castings there will be light and and dark spots, and many are the conjectures as to the cause.

If the castings are well cleaned and freed from scale and grease, the trouble is due to the structure of the casting. There will be soft and porous spots—spongy—and these, when dipped, will absorb more of the lacquer than the denser portions. Unless these can be washed out the spots will always show up. Only by cutting out the spot, which is not practical, or by washing to remove the excess can an even finish result.

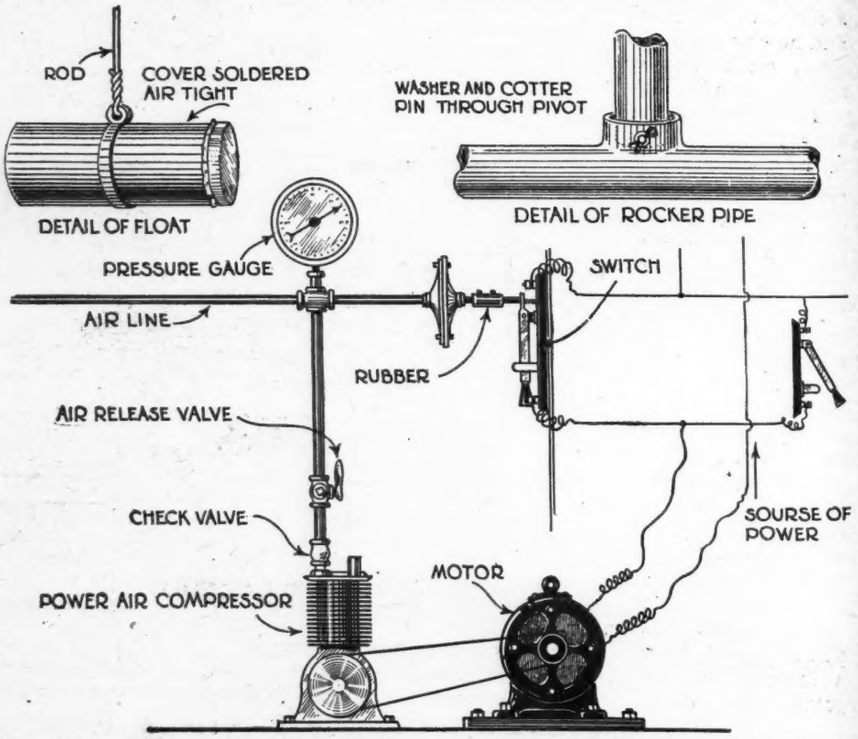
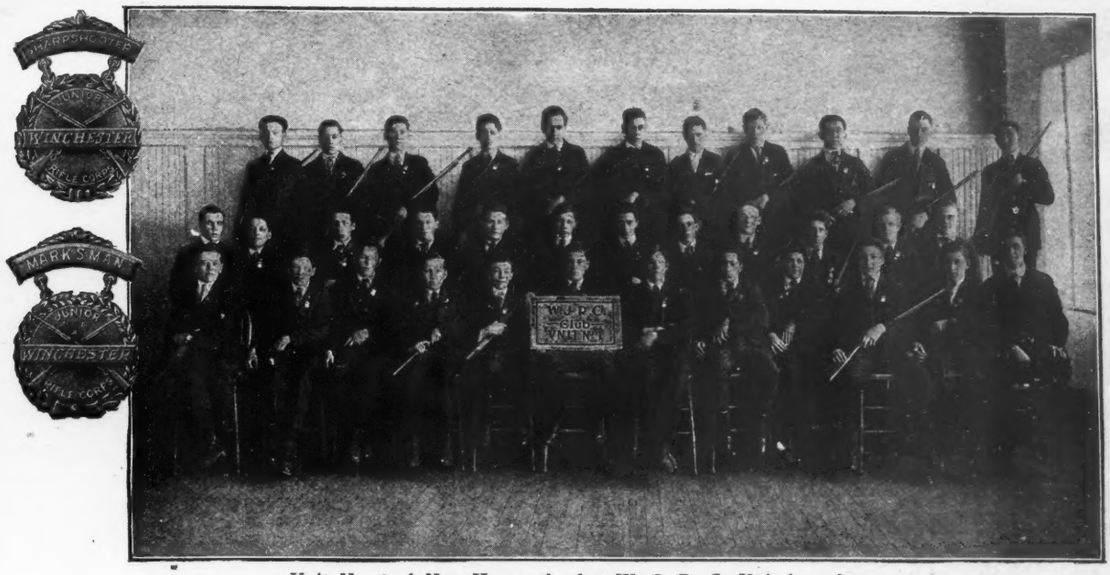
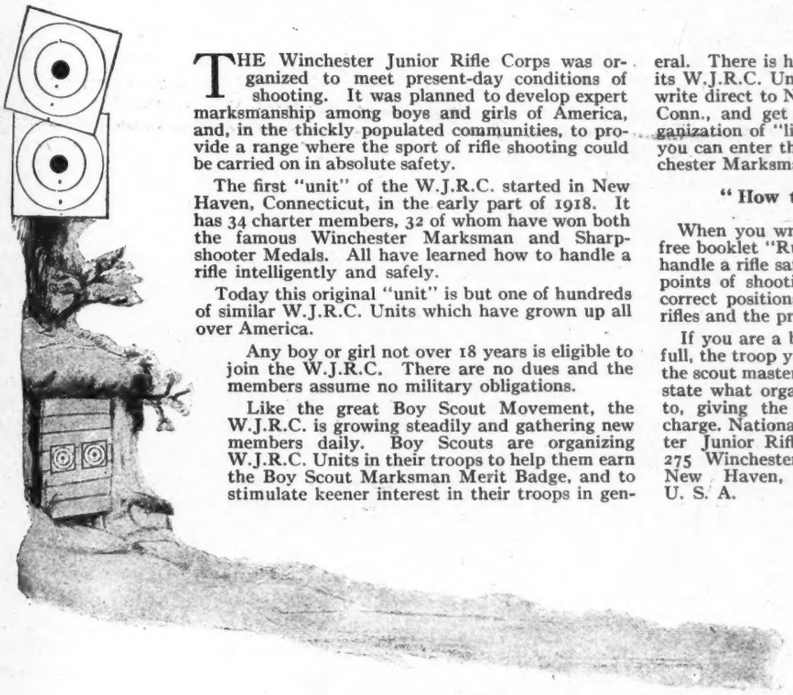


Fig. 3. Where electric power is installed, this simple motor drive may be used for operating the system with air-pressure. It works automatically by the pressure in the tank



Unit No. 1 of New Haven, the first W. J. R. C. Unit formed

How the Winchester Junior Rifle Corps first started



THE Winchester Junior Rifle Corps was organized to meet present-day conditions of shooting. It was planned to develop expert marksmanship among boys and girls of America, and, in the thickly populated communities, to provide a range where the sport of rifle shooting could be carried on in absolute safety.

The first "unit" of the W.J.R.C. started in New Haven, Connecticut, in the early part of 1918. It has 34 charter members, 32 of whom have won both the famous Winchester Marksman and Sharpshooter Medals. All have learned how to handle a rifle intelligently and safely.

Today this original "unit" is but one of hundreds of similar W.J.R.C. Units which have grown up all over America.

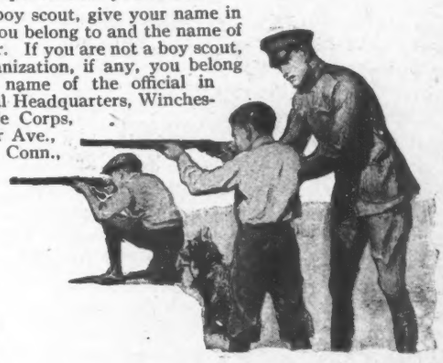
Any boy or girl not over 18 years is eligible to join the W.J.R.C. There are no dues and the members assume no military obligations.

Like the great Boy Scout Movement, the W.J.R.C. is growing steadily and gathering new members daily. Boy Scouts are organizing W.J.R.C. Units in their troops to help them earn the Boy Scout Marksman Merit Badge, and to stimulate keener interest in their troops in general. There is hardly a town now that has not got its W.J.R.C. Unit. If there is none in your town, write direct to National Headquarters, New Haven, Conn., and get the facts about this patriotic organization of "live" American boys, and learn how you can enter the competition for the famous Winchester Marksmanship and Sharpshooter Medals.

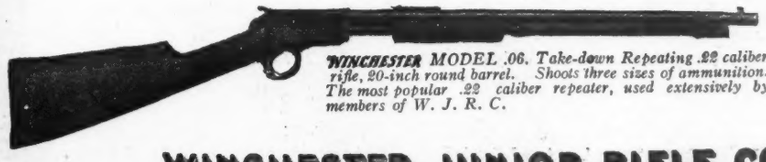
"How to handle a rifle safely"

When you write in to headquarters, ask for the free booklet "Rules of the W.J.R.C." and "How to handle a rifle safely." It tells you in detail the fine points of shooting, alignment of sights, the three correct positions, rules for gun safety, the care of rifles and the proper rifle for you to use.

If you are a boy scout, give your name in full, the troop you belong to and the name of the scout master. If you are not a boy scout, state what organization, if any, you belong to, giving the name of the official in charge. National Headquarters, Winchester Junior Rifle Corps, 275 Winchester Ave., New Haven, Conn., U. S. A.



WINCHESTER *Take-down .22 Caliber Single Shot rifle. A low priced, light weight gun made in two sizes.*



WINCHESTER *MODEL .06. Take-down Repeating .22 caliber rifle, 20-inch round barrel. Shoots three sizes of ammunition. The most popular .22 caliber repeater, used extensively by members of W. J. R. C.*

Winchester Junior Rifle Corps
National Headquarters, 275 Winchester Ave. New Haven, Conn., U. S. A. Division] 220.

Gentlemen:

Please register my name as a member of the Winchester Junior Rifle Corps, and send me a membership button and certificate of membership. Also tell me how to organize a Local Unit of the W. J. R. C.

Very truly yours,

Name.....

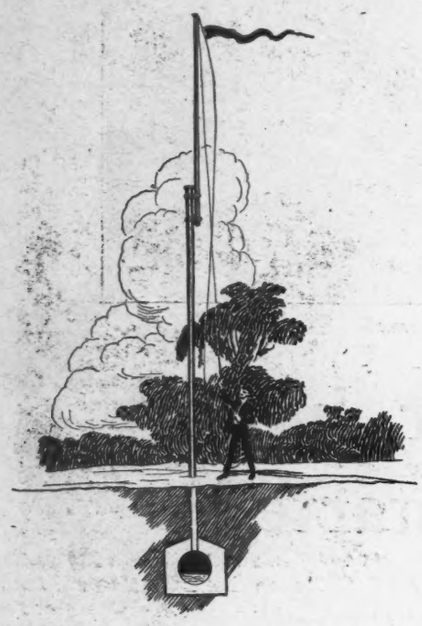
Street Address.....

City..... *State*.....

WINCHESTER JUNIOR RIFLE CORPS

Lower Section of a Flag-Pole Used for a Sewer Vent

A REAL estate man in a New York suburb encountered a serious problem in developing one of the residential sections when a deep sewer was put in through the property from an adjoining town. The sewer was about



The lower part of this flag-pole is a gas-pipe which taps the sewer main to vent it

100 ft. below grade, but because of the great pressure it was necessary to vent it almost in the middle of his development scheme. Such a vent would have been a public nuisance and put a heavy handicap on the selling of the property. The mere presence of such a sewer vent, even though harmless, would prevent many people from buying the land.

One day he hit upon the clever device shown in the picture. It consisted of carrying the vent up into the air about 60 ft. and then splicing another pole to the top with an American eagle at the end and all the attachments of a real flag-pole. The flag-pole ventilator is so perfect a cover for the vent that most of the people who live in the neighborhood do not even know its real purpose. Not only does it act as a disguise for the sewer vent, but it also carries the gases far enough up in the air to render them unobjectionable.

People have often wondered why the flag-pole never has a flag on it. Many a traveling steeple-jack has called on the owner of the property to ask whether he would allow him to fix the pole for flying a flag. The owner, however, has let it be known to a few that he will never let the American flag fly from a mast that is a sewer vent. He says it goes against his pride for the flag. So, to this day, the pole has never had the Stars and Stripes fly from it, although it is as perfect a flag-pole as could be built.

Signal to Warn Driver Emergency Brake Is Engaged

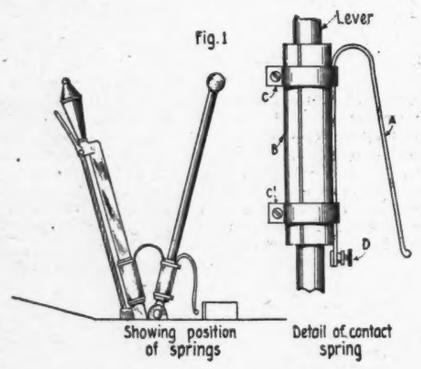
BURNED out brake-bands, broken crank-shafts, and enormous fuel consumption are only a few of the many evils that may result from driving a car with the emergency brake locked in position.

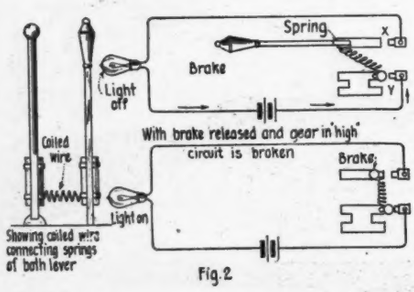
After a friend had told him how he had unwittingly driven over twenty-five miles under such conditions, L. B. Robbins, a Florida inventor, set about to devise a means of preventing just such occurrences. The idea can be applied to any "shift gear" type of car, and calls for only the simplest materials.

The essential element is a contact spring applied to each lever, that is, the emergency-brake and gear-shift lever, just far enough above the floor of the car to allow easy shifting.

The spring is a strip of tempered brass, bent as shown, one end being fitted with a screw terminal. This can be found on an old dry-cell. A short length of rubber garden hose is slit down its length and slipped over the lever to act as an insulator and to keep the two metals apart. The spring is clamped to the hose with a pair of common hose-clamps. The two terminals are then connected by a coiled piece of ordinary bell wire as shown in the illustration.

Attach a metal contact strip to the floor-board immediately behind each lever, so that, when the gears are in "high" and the emergency brake is set, there will be contact between the spring strip on each lever and the metal directly behind it.





A contact spring on each lever makes a signal light show when the brake is engaged

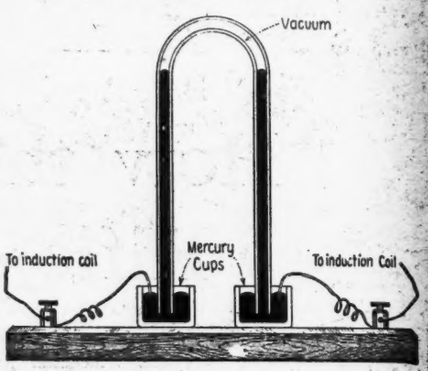
Wire these two floor strips to a light or bell, as preferred, which is placed on the dash, and insert one cell of the battery in the circuit.

When the car is started the emergency brake is thrown out and the gear lever finally pulled back to bring the spring in contact. The circuit is then open.

If, however, the brake is accidently left engaged and the gear lever engaged in high, the circuit is at once completed and a signal gives warning to the driver.

How to Make an Experimental Geissler Tube

THE best results and effects are obtained with discharges from the secondary of an induction coil in glass tubes when the exhaustion is carried to a pressure of about 2 mm.



A U-tube filled with mercury and inverted into two vessels of mercury

of mercury, and the tubes are permanently sealed. However, for experimental purposes a Geissler tube made as described herein gives most satisfactory results. Procure glass U-tube about 34 in. high. Fill it with clean mercury, close the ends with the fingers and invert it into two vessels of mercury.

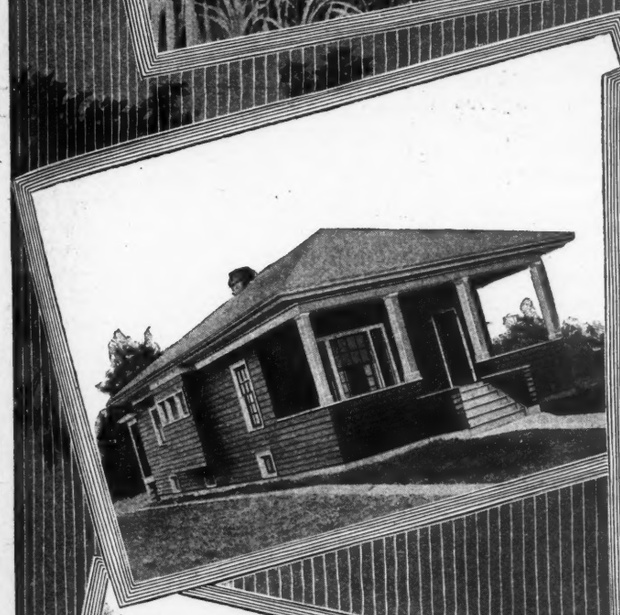
Upon removing the fingers, the mercury columns in the two arms will fall a few inches, as shown in the accompanying sketch. This will create a vacuum in the upper part of the tube, known to physicists as a Torricellian vacuum.

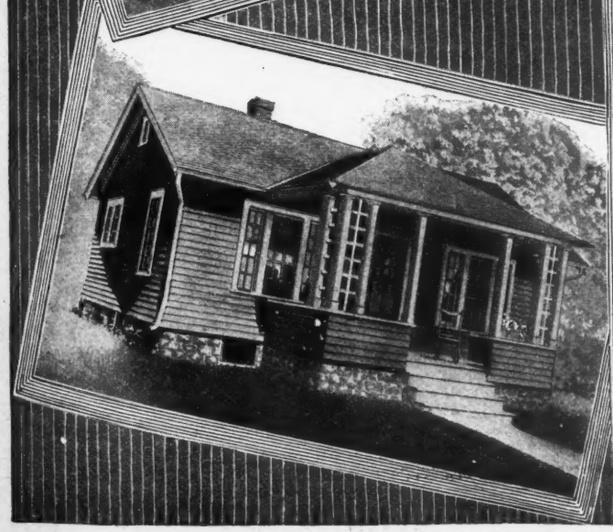
Wires are led from the mercury cups to two binding-posts, as shown. If the electrodes of an induction coil are connected with these terminals, a luminous phenomenon is produced in the vacuum in the upper section of the tube.

This experiment may be varied by carefully admitting different gases and vapors into the evacuated space. The luminous effects obtained thereby are very beautiful. Different gases produce different colors.

The colors are determined by the nature of the residual gas. Hydrogen glows with a brilliant crimson; the vapor of water gives the same color, indicating that the vapor is dissociated by the discharge.

An examination of this glow by the spectroscope gives the characteristic lines of the gas which is enclosed in the tube.—PETER J. M. CLUTE.





Before You Build

Send for The Sterling Plan Book

EVERY prospective home builder should send for the new book of Sterling System Homes before making any plans. Every home shown in beautiful colors and described in detail with plans. From the modest cottage or bungalow, to the pretentious mansion—all designed by architects who know how to give you the utmost in convenience of arrangement and modern design.

Sterling System Homes

Are built by the famous Sterling System—from forest direct to you without middlemen's profit—most economical and practical method of building ever developed. All parts cut to fit exactly without waste of material or time. All there is to do is have your carpenter put the parts together when they are received.

Save on Your New Home

When you build a Sterling System Home you save all the waste of material and the waste of time of the old "Handsaw Method". All extras cut out and all middlemen's profits saved because you buy direct from the men who own the very forests that yield the logs for your Sterling Home. Send today for the DeLuxe Sterling Book which shows how this saving can be made.

Send This Coupon

and 10c today. We will mail you the new 1919 Sterling System Book of Homes. Every home beautifully illustrated in colors. This is the most elaborate, attractive and informative book of its kind ever issued. Just full of valuable information that every home builder should have. Send for your copy.

International Mill and Timber Co. Dept. 1202 **Bay City, Mich.**

Enclosed find 10 cents. Please send me your Sterling System Book of Homes.

Name.....

Address.....

A Sidewalk Mirror as Lookout for Street-Car Passengers

ON cold winter days travelers are apt to step into a corner drug-store to wait for the street-car. In one store, to prevent the opening of the door unnecessarily and letting in cold air, a mirror was fastened to a pole at the sidewalk edge so that it reflected the car-track and approaching cars. The illustration shows how the mirror on the pole outside is seen from within the store.—H. W. HAHN.

A mirror placed on a post at the sidewalk edge, where it reflects approaching cars for travelers waiting in the corner store in winter-time

A Double-Action Disappearing Stairway

FARM buildings, as a rule, are greatly cramped for room, and anything permanently in the way is a great inconvenience. Stairs to lofts and upper floors are one of the things that are apt to take up valuable space, but yet to be continually shifting ladders about from one loft to another requires considerable labor. Therefore the ladders or stairs illustrated are intended to overcome both the labor of changing stairs and the waste of space. They can be arranged over the partition between two rooms, and when the space occupied by the stairs in one room is needed they can be raised and access to the floor above can be had from the other room. The illustrations are self-explanatory.

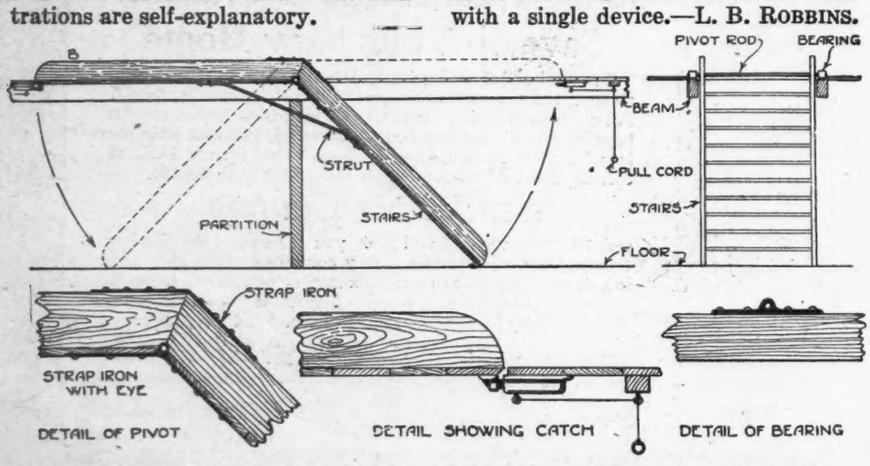
Two runs of stairs are built of light but stout lumber after the pattern shown. If the second floor is 10 ft. above the first, the stairs should be about 14½ ft. long in order to furnish an easy climb. Bevel the butting ends of the stairs together, so that when one pair is raised exactly level, the other set will touch the floor at a 45-degree angle.

Tie the two sets together at the top with strap irons and lag screws, as shown in detail, with another strap iron, furnished with an eye about 1 in. in diameter, on the under side. Then run a strong iron strut across between the two stairs to overcome any tendency to sag. If properly constructed the stairs should counterbalance at the eye where they join. If they do not, add a slight weight on the lighter end until a balance is reached.

Cut an opening in the upper flooring, the width between two beams. The ladders should be made so that they will fit between them. Have a pair of iron plates made with an eye for a bearing, and bolt it to the upper floor, as shown in detail. Then pass a 1-in. iron or steel rod through the two eyes on the stairs and into the bearings on the upper floor. This forms a pivot upon which the whole arrangement swings. Suspend a pull-cord with a ring from each section to pull it down to the floor.

Where the swinging end of each section enters the opening, arrange a spring-bolt that will shoot in place under the stairs and therefore hold it up in place to insure safety from falling down if a weight were thrown upon it. Arrange a pull, as shown, so that the catch may be withdrawn to allow the opposite end to be raised.

This forms a splendid method of overcoming useless steps in the day's work, and of securing more than one means of gaining access to upper floors from different locations and with a single device.—L. B. ROBBINS.

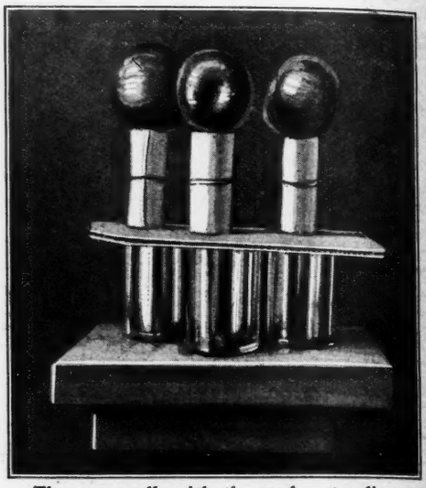


The double-acting stairway provides a means for entering the floor above from two positions. While the stairway is down where it is needed it is up in the room where it is not required, the angle which each ladder makes with the floor being 45°

It's Simple When You Know How It's Done

THIS feat has all the ear-marks of a difficult juggling act and one that has been perpetrated as such on the professional stage. It makes an excellent parlor stunt or after-dinner trick.

Procure three glasses of any size, and arrange them on any table so that two of the glasses will be toward the front and the remaining one in the rear, triangular fashion. Then over these glasses place a piece of cardboard, a tray, or a flat magazine. On top of this set three uprights, one directly over each glass. The uprights are made by rolling a card in the form of a tube and pasting or pinning the edges. Three small wood uprights will answer as well. Carefully place an apple, or a tennis ball, or any round object—a potato will do—on top of each upright.

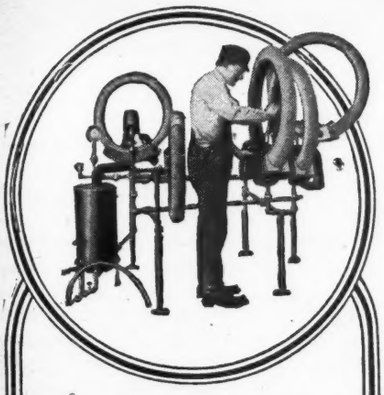


The paper rolls with the apples standing on top of them are placed directly over the glasses on a cardboard covering

After the articles are so set, stand at one side of the table and ask for the attention of your spectators. Give the cardboard or tray—whichever you use—a smart rap with the palm of your hand, and it will sail to the floor, carrying the uprights with it, but leaving an apple in each glass.

It looks like a trick calling for considerable practice, but as a matter of fact you can do it at the first trial, the only caution necessary being to set the uprights bearing the apples directly over the glasses. The tray does not necessarily have to be knocked away—you can get a firm grasp on it at one corner and pull it toward you quickly. The result will be the same. Failure is impossible if the objects are arranged directly above the glasses.

The quick removal of the card does not transfer its movement to the apples, and they fall directly into the open mouths of the glasses. The reason for this is that the apples are too heavy to be influenced by the side movement of the cardboard, their only tendency being to drop. The paper rolls which support them are very light and move with the cardboard.



Make This Your Business at $3,000 per Year

Automobile Tire Surgery. There isn't a business you could get into that offers such sure possibilities of **success and fortune.** One man and a Haywood Equipment can make $250 a month and more. Scores already have done it and this year there is a greater demand than ever for tire repair work.

"30 Million Tires to Repair"

That's not a myth nor some man's dream. It's an actual fact. The factories everywhere are building new buildings—enlarging their plants for the biggest period of prosperity in the automobile business. **30 million tires will be manufactured and every one will need repairing.**

No Experience Necessary

No previous training, no apprenticeship. We have a complete course, plainly and profusely illustrated, that explains everything. This course is Free with each equipment. If you have a little mechanical turn of mind, you can quickly become an expert. You learn in a week. Handle all kinds of jobs—figure prices at big cash profits. Nothing is easier to master completely.

This is Richard A. Oldham

HE EARNED $2200.00 IN 4 MONTHS with 1 Haywood Machine. Mr. Oldham was telegraph operator for The Illinois Central Ry. 20 years. He is now 58 years old. He just wrote us: "I have earned as much in 4 months as in 2½ years as telegraph operator."

INVESTIGATE. Send the coupon below, a letter or postal. This brings full information—and a big interesting catalog. Tells all about tires and how to repair them. Shows how to make money—to become independent. Do this today—NOW—before you forget it.

Haywood Tire & Equipment Company
1167 Capitol Ave., Indianapolis, Ind.

FREE CATALOG COUPON
Haywood Tire & Equipment Co.
1167 Capitol Ave. Indianapolis, Ind.
Gentlemen:—Please send me your catalog, details and plans for starting ambitious men in the Tire Repair business.
Name.....
Address.....
.....

BOOKS ON FLYING

Building and Flying an Aeroplane—A practical handbook covering the design, construction and operation of aeroplanes and gliders. Cloth 150 pages. 50 illustrations.

Price, $1.00 postpaid

Harper's Aircraft Book—Why aeroplanes fly, how to make models, and all about aircraft little and big. It explains in a simple, lucid manner the principles and mechanisms involved in human flight, and tells how to design and construct model aeroplanes, gliders, and man-carrying machines. 245 pages. Illustrated.

Price, $1.10 postpaid

POPULAR SCIENCE MONTHLY
225 West 39th St., New York, N. Y.

How to Prevent Machine Screws from Rusting

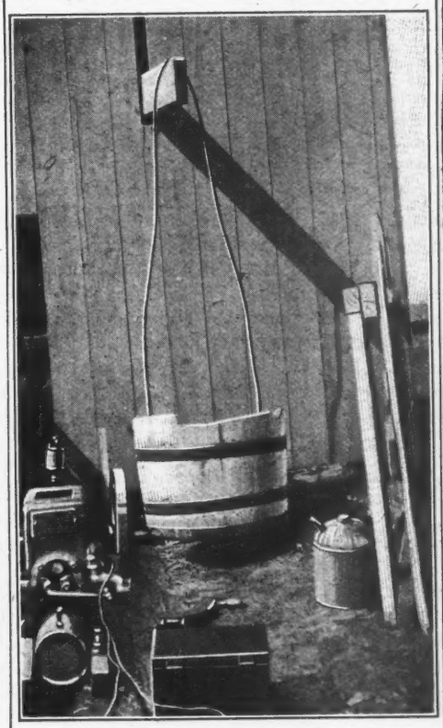
SCREWS employed to join machinery will become fixed, and after a time they will be difficult to remove because of oxidation. To prevent this a mixture of graphite and oil should be used. This will effectually protect them from rust for years. The mixture is an excellent lubricant, which facilitates tightening the screws as the friction is reduced in the threads and hole.

An Aid in Saving Gas at the Farm Pump

A SMALL gasoline engine of 1½-horsepower, plus a tubful of rocks, can pump as much water from a deep well as can a 3-horsepower engine unaided. This fact was discovered by a farmer who owned a 300-ft. well, which was pumped by a windmill until an engine was installed two years ago. Both a 1½ horsepower engine and a 3-horsepower one were tried.

A 3-horsepower engine was first used, but, in order to conserve gas, the farmer is now pumping with half the power. This instance, the pump is inclosed in a small wooden building and the engine is placed outside of the building.

Beside the engine is a tubful of rocks suspended from a beam. The beam moves up and down in the slit in the side of the pump-house, as shown in the picture. As the tubful of rocks descends with a jerk, the weight aids the engine in lifting the water. The beam is attached to a timber, which is connected with the pump. The engine starts the pump and sets the beam in motion.—F. L. CLARK.



A tubful of rocks on a beam helps an engine to pump water from a deep well

Big Business and the MULTIPLEX HAMMOND "WRITING MACHINE"

"Many Typewriters In One"

The business executive will appreciate the ***force of emphasis*** permitted by the ***interchangeable type*** system of the Multiplex Hammond.

Statistical reports, loose leaf manuals, index cards, etc., revolutionized through the ability of the new Multiplex to condense typewriting to 1/4 the space usually occupied.

The Multiplex Petit Gothic type sample reproduced above (exact size), shows the possibility of condensing your work in perfectly clear manner to one-quarter the usual space. This is invaluable for ***executives' manuals, analytical statements, index cards, etc.***

No other typewriter can do this—

By "Just turning the Knob" you can change from one style or size of type and spacing to another. There are over 365 different arrangements of types and languages to select from.

Business letters written in the beautiful Hammond Roman, with the emphasized portions in ***striking italic,*** invariably compel attention and respect.

Verily, the Multiplex is the—

Typewriter of Personality

Because of the instantly interchangeable type, the perfect alignment, the uniform impression, and many other exclusive features, the Multiplex Hammond is famous throughout the world as the typewriter ***par excellence.***

Our ***free booklet*** will be sent upon request, if you are a business executive. Mail the coupon NOW.

Sent free upon request

Multiplex in the Home and for traveling.

Weighs only 11 pounds. Full capacity. Write for ***special*** folder.

Coupon

The Hammond Typewriter Co.
639 East 69th St., New York City
Please send free folder to:
Name.....
Address.....
Occupation.....
Ask about special terms to professionals

The New Portable

Multiplex Hammond

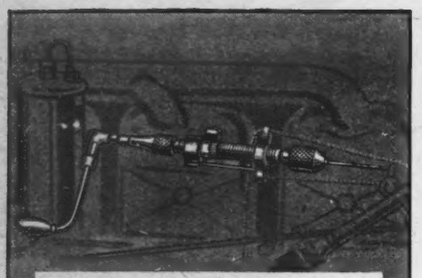
Only 11 Pounds

Full Capacity

This new light-weight aluminum model travels in a miniature plush-lined leather case. ***Take it with you on your business or pleasure trip.*** You forget you have it, until you need it. Write for special descriptive literature, sent Free, and for the unique brochure, "The President and His Typewriter."

Two of the many styles of type

Two different styles of type always in the machine—"*Just turn the Knob*"



Drilling end of accelerator lever. Use of "YANKEE" Chain Drill avoids necessity of removing any part of construction.

No Hand Feeding

The "YANKEE" Chain Drill is really more than a tool; it is actually a highly efficient machine that automatically relieves the user of effort and responsibility.

The drill is quickly run up to the work by the "YANKEE" Friction Feed; then at the touch of a lever, the "YANKEE" Ratchet Feed takes hold and feeds the drill through the cut without attention from the operator. Saves hand feeding; saves time; saves drills.

Other conditions being equal, no man, using ordinary tools can successfully compete with the user of "YANKEE" tools.

"YANKEE" Chain Drill

No. 1500, 3 Jaw Chuck for round shank drills up to ½ in. Length 9¼ in. Weight 3½ lbs.

No. 500. 2 Jaw Chuck for square shank drills up to ½ in. Length 10¾ in. Weight 3½ lbs.

Price $4.50

Your Dealer Can Supply You

Write for free "YANKEE" Tool Book illustrating efficiency tools.

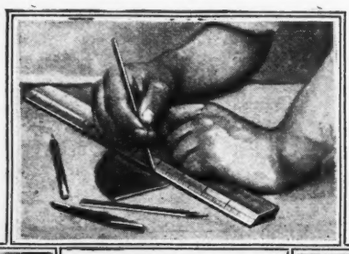
North Bros. Mfg. Co. Philadelphia

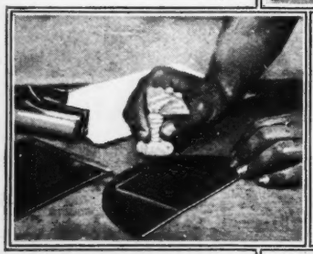
"YANKEE" TOOLS

Make Better Mechanics

How to Make Cuts from Linoleum for Printing Purposes

THE surface of linoleum is suitable for use in printing, and if designs are cut thereon, or letters shaped in a reversed position, a very pleasing effect may be obtained. The first step in the preparation of one of these cuts is the drawing, which must be made on paper and then transferred upside down to the linoleum. The transferred design must be redrawn in ink, so that the lines will be plainly visible. All the parts not to be inked must be cut out.





After the design is carefully drawn on paper it is transferred to the linoleum; then the parts are cut out with a sharp knife making the white spaces

Inking the cut, getting it ready for making the impression on the paper

Pulling the finished print from the cut surface after the impression is made

Rolling the paper down on the cut to make it re-receive the impression

With a small sharp knife all black spaces are perpendicularly edged. Then, with a side motion of the fingers, the white parts are cut out. One must be careful not to undermine any of the inked lines. When these parts have been cut out, the design, which will stand out prominently, is inked by lightly tapping the linoleum surface with a wad of cotton soaked in ink. A piece of paper held in the left hand is then carefully placed over the design and heavily rolled with the other hand. When the roller has gone over the design once, the paper is taken off. Thousands of prints can be made from one design, or cut, for it will last a lifetime.—E. BADE.

Dynamic Balancing of Machine Parts

A ROTOR with a good static, or stationary, balance will not necessarily be in good balance while running. It is often necessary to rebalance the revolving member dynamically after the assembly of the machine. First the shaft of the machine must be straight before any balancing is attempted. This can be easily determined by holding a pencil or pointer to the shaft while the latter is slowly revolved. If the pointer touches all points the shaft is straight, and the procedure of balancing may be started. If it does not touch all around, the shaft has been sprung, and must be straightened before starting to balance the rotor dynamically.

To locate roughly the proper position for balancing, hold a piece of chalk so that the high side of the shaft strikes it as the rotor revolves at normal speed. On the rigid shaft the mark thus made will indicate the heavy side; but on a flexible shaft it will probably indicate the light side of the rotating part. Fasten some weight on the side opposite the mark, and repeat the operation. If it is improved, the weight is in the proper place, and the mark will be found to extend farther around the shaft. If the mark is found to have moved, the weight should be added at the new point. If the mark is found immediately opposite, the reason is that too much weight has been added.

A Tune May Be Played with the Noise of Running Gears

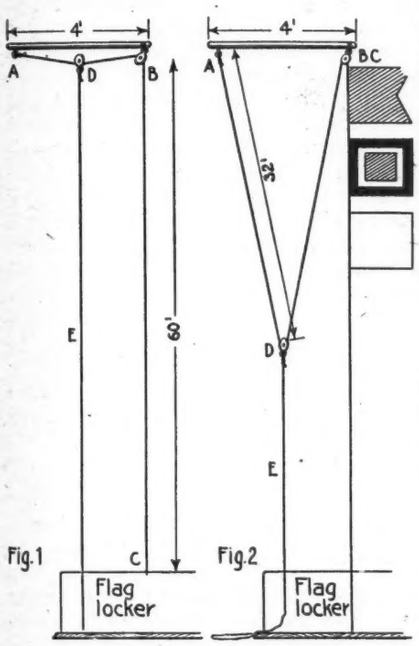
GO into the feverishly busy machine shops of to-day and watch the rapidly traveling belts and the noisy gears. The outsider is completely bewildered by the noise—some say the workmen become used to it, others that it distracts them too. Some gears are noisier than others. In fact, a vaudeville turn, as yet untried on the public, is to house a number of sets of moving gears and, by opening doors leading to the sets, to release the noises and play popular and patriotic airs through them.

For the noise of the gears has "pitch," and the more rapidly moving gears give off the higher tones. It has been determined that the number of teeth contracting, or meshing, in a minute has an exact bearing on the pitch of the tone. The tone *A* on a piano of low pitch is produced by the vibrations of the strings creating sound waves to the number of 435 per second. And if 435 gear teeth pass a given point in mesh with another gear in a second, the sound will have the pitch of *A*. And so with every other speed—it has a counterpart on the piano scale.

Speeding up Flag-Hoisting on Battleships

DURING a recent competition in signaling held by battleships of the American fleet, an interesting incident took place. One period was given over to flag-hoisting, the object being was speed and accuracy. Since the penalty for each wrong flag hoisted was a 50 per cent reduction in the score, accuracy was rated as most essential. Some one suggested a system of blocks to insure greater speed and thus gain precious seconds to be devoted to accuracy, and the following plan was worked out and it proved very successful when used in the signalling contest.

A small block, *B*, was made fast to the yardarm 4 ft. from the eye-bolt *A*. The hoisting distance, that is, the distance from the flag-locker to the yardarm, was 60 ft. A signal halliard was roved through block *B* and block *D*, which hung loosely to the halliard and made fast to the eye-bolt *A*. The lower end *C* was cut flush with the top edge of the flag-locker and a snap sewed thereon. Halliard *A*, *B*, and *C* was therefore 64 ft. long.



A form of block-and-tackle pull on a rope for hoisting the flag quickly

The hauling part *E* was made fast to the ring on the block *D*, which is inverted, and led to the deck. This is illustrated in Fig. 1. It will be seen that when halliard *E* is hauled down, snap *C* goes up with the flag until it is flush with the block *B*. The halliard *A*, *B*, and *C* has now assumed the shape of a large V, as seen in Fig. 2, forming two sides of an inverted isosceles triangle, with the yard-arm as a base.

A glance will show that block *D* has traveled a distance equal to the perpendicular bisector of the isosceles triangle—in this case a little less than 31 feet—M. M. CLEMENT.

Why I Am Paid $50,000 A Year

How a Poor Young Man Trained for a Big Job — and Got it in Three Years

AS TOLD TO S. D. HOPKINS

THERE are only a few $50,000 jobs—yet of all the men in the country it is difficult to find enough to fill the few big jobs available. There are plenty of men for the $25-a-week positions—but the thousand-dollar-a-week openings "go begging." How this young man trained himself for earnings of $50,000 a year is one of the most interesting chapters in the annals of even present-day fortune making. This is the story told me, almost word for word, by the young man who did it.

"Three short years ago I was $5,000 'in the hole'—and earning $30 a week. I had a wife and two children to support, and I used to worry myself sick about the future.

"Today—it seems like a dream—all my troubles are over. I am worth $200,000—enough to keep me and my family in comfort for the rest of our lives. I own two automobiles. My children go to private schools. I have just purchased, for cash, a $25,000 home. I go hunting, fishing, motoring, traveling, whenever I care to.

"Let me say in all sincerity that what I have done I believe anyone can do. I am only an average man—not 'brilliant'—have never gone to college—my education is limited. I know at least a hundred men who know more than I, who are better educated and better informed—and their earnings probably average less than $50 weekly while my income is over $1,000 weekly. I mention this to show that earning capacity is not governed by the extent of a man's education—to encourage those who have not had the advantage of a comprehensive education.

"What, then, is the secret of my success? Let me tell you how it came about.

"One day, about three years ago, something happened that woke me up to what was wrong with me. It was necessary for me to make a decision on a matter which was of little consequence. I knew in my heart what was the right thing to do, but something held me back. I said one thing, then another; I decided one way, then another. I couldn't for the life of me make the decision I knew was right.

"I lay awake most of that night thinking about the matter—not because it was of any great importance in itself, but because I was beginning to discover **what was wrong with me.** Along towards dawn I resolved to make an experiment. I decided to cultivate my will power, believing that if I did this I would not hesitate about making decisions—that when I had an idea I would have sufficient confidence in myself to 'put it over'—that I would not be afraid of myself or of things or of others. I felt that if I could smash my ideas across I would soon make my presence felt. I knew that heretofore I had always begged for success—had always stood, hat in hand, depending on others to give me the things I desired. In short, I was controlled by the will of others. Henceforth, I determined to have a strong will of my own—**to demand and command what I wanted.**

"With this new purpose in mind I applied myself to finding out something more about will power and in my investigation I encountered the works of Professor Frank Channing Haddock. To my amazement and delight, I discovered that this eminent scientist, whose name ranks with James, Bergson, and Royce, had completed the most thorough and constructive study of will power ever made. I was astonished to read his statement, 'The will is just as susceptible of development as the muscles of the body!' My question was answered! Eagerly I read further—how Dr. Haddock had devoted twenty years to this study—how he had so completely mastered it that he was actually able to set down the very exercises by which anyone could develop the will, making it a bigger, stronger force each day, simply through an easy, progressive course of training.

"It is almost needless to say that I at once began to practice the exercises formulated by Dr. Haddock, and I need not recount the extraordinary results that I obtained almost from the first day. You already know the success that my developed power of will has made for me.

"People sometimes worry because they cannot **remember** or because they cannot **concentrate.** The truth is, will power will enable them to do **both.** The man who can use his will can not only concentrate and remember but can **make use** of these two faculties. And I want to leave this one word with you—no knowledge, no plan, no idea, is worth a penny unless it is used—and it cannot be used unless someone's power of will does it!"

Prof. Haddock's rules and exercises in will training have been placed in book form, and I have been authorized by the publishers to say that any reader who cares to examine his startling book on will power may do so without sending any money in advance. In other words, if after a week's reading you do not feel that "Power of Will" is worth $3, the sum asked, return it and you will owe nothing. When you receive your copy for examination I suggest that you first read the articles on: The law of great thinking; How to develop analytical power; How to guard against errors in thought; How to drive from the mind unwholesome thoughts; How to develop fearlessness; How to use the mind in sickness; How to acquire a dominating personality.

It is interesting to note that among the 250,000 owners who have read, used and praised "Power of Will" are such prominent men as Judge Ben B. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, ex-U. S. Chinese Ambassador; Gov. McKelvie of Nebraska; Assistant Postmaster-General Britt; General Manager Christeson, of Wells Fargo Express Co.; E. St. Elmo Lewis; Senator Arthur Capper of Kansas, and thousands of others.

As a first step in will training, I would suggest immediate action in this matter before you. It is not even necessary to write a letter. Use the blank form below, if you prefer, addressing it to the Pelton Publishing Company, 14-B Wilcox Block, Meriden, Conn., and the book will come by return mail. This one act may mean the turning point of your life as it has meant to me and to so many others.

PELTON PUBLISHING COMPANY
14-B Wilcox Block, Meriden, Conn.

I will examine a copy of "Power of Will" at your risk. I agree to remit $3 or remail the book in 5 days.

Name .....

Address.....

.....

If You Need Training Read This Guarantee

We guarantee at any time during the first year of your enrollment to refund the entire amount paid if immediately upon the completion of 10 examinations you notify the school you are not satisfied with the Course

SOUNDS convincing, doesn't it? Better still, it means if we make good, YOU MUST. More than that, it show's we're confident in our ability to fit you for the Big Job—and the pay you'd like to get. If you want to succeed, but are handicapped by the lack of training, NOW is the time to make us MAKE GOOD. We can't come to you—but the Coupon below will bring us together in such a way that you can't lose a cent. We're ready to make good. YOU CAN IF YOU WANT TO.

NO STRING TO OUR OFFER

There's no quibbling about the American School guarantee. *You're either satisfied or you are not.* After the tenth examination, if you feel that you are not getting practical, money-making instruction, **knowledge you can cash in on,** simply notify us you are not satisfied with the Course and you are not out one cent. We accept students on no other basis but that of satisfaction or money back.

IT'S YOUR MOVE

You've read our Guarantee—you know that training will pave the way for promotion and better pay—you know you can't hope to really get anywhere without specialized instruction—so why not GET IT? The first move for a bigger and better future is to check and mail the Coupon. We'll promptly mail you Free Bulletin and full details of Money-Back Guarantee.

AMERICAN SCHOOL
OF CORRESPONDENCE
Dept. T1202 CHICAGO, U. S. A.

TRAINING THE KEY TO SUCCESS

Explain how I can qualify for the position checked. ASC

....High School Course	....Shop Superintendent
....Electrical Engineer	....Lawyer
....Telephone Engineer	....Business Manager
....Architect	....Auditor
....Draftsman and Designer	....Certified Public Accountant
....Building Contractor	....Stenographer
....Structural Engineer	....Bookkeeper
....Mechanical Engineer	....Fire Insurance Adjuster
....Civil Engineer	....Sanitary Engineer
....Steam Engineer	....Automobile Engineer

Name .....

Address .....

Learn Watch Repairing

Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.

Ask for our Free Book. It explains our system and terms.

THE DeSELMS WATCH SCHOOL
687 Perry St., ATTICA, IND.

Submit your Song Poems NOW for free examination and advice.

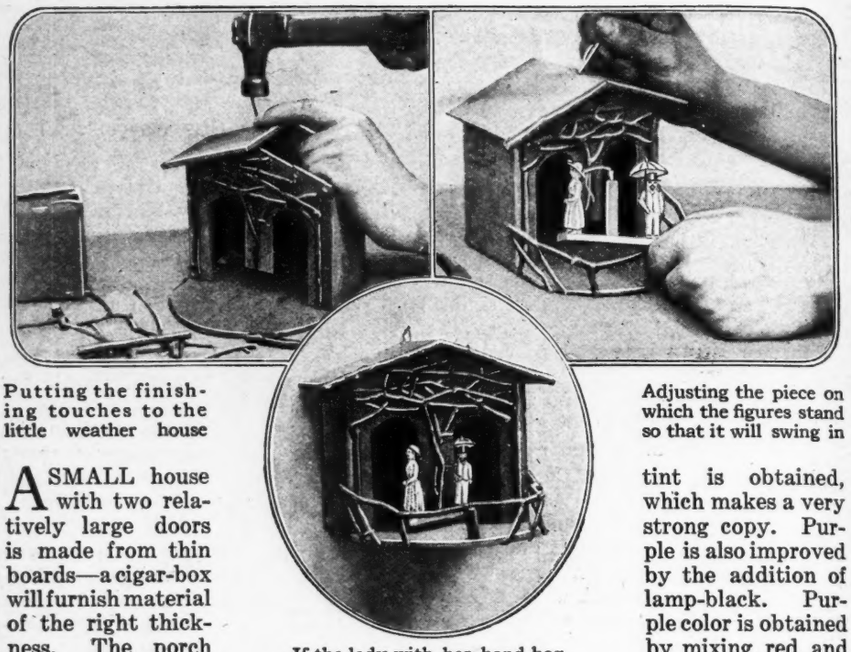
We revise poems, compose music of any description, secure copyright and employ original methods for facilitating FREE PUBLICATION or outright SALE of songs under a certificate GUARANTEEING you satisfaction. A Postal Card brings you a copy of our Free Booklet which tells you who we are, explains our methods and contains valuable information and instructions. This is your opportunity to learn the truth regarding the Song-writing profession from a reliable and successful concern.

SONG WRITERS MANUAL & GUIDE SENT FREE

KNICKERBOCKER STUDIOS, 88 Gaiety Bldg., N. Y. City

Arithmetic of Electricity—A practical treatise on electrical calculations of all kinds reduced to a series of rules. $1.00 *Postpaid.* Popular Science Monthly, 225 West 39th St., New York.

Is It Going to Rain? Watch the Weather House



Putting the finishing touches to the little weather house

Adjusting the piece on which the figures stand so that it will swing in

If the lady with her hand-bag comes forth for a day's shopping, it is going to be clear

A SMALL house with two relatively large doors is made from thin boards—a cigar-box will furnish material of the right thickness. The porch and the front of the house are decorated with branches to give it a rustic appearance. Two figures—a man with an umbrella and a woman with a handbag—are placed on a small board so that they stand in the center of the doorway. In the center of this board is a small rod, its length a trifle longer than the figures are high, with a hook in the upper end.

Get an E-string for a violin—not steel, catgut—and tie it in the hook; fasten the other end to the roof of the house, so that the figures will lean about ¾ in. back of the doorways. If one of the figures should be a trifle heavier than the other, a few drops of sealing-wax on the lighter one will equalize the weight.

The man with the umbrella predicts bad weather, and the gaily dressed woman with the handbag fair weather. When a drop of water is placed upon the E-string, the side that predicts rain will come out of one doorway, while the fair-weather side will retreat into the house. This test, of course, must be made before the figures are attached to the swinging board.—DR. BADE.

How to Make Carbon Copying Paper for Typewriters

USERS of carbon paper often wish to use a deeper color than those usually sold in the stores. The commercial paper has a standard tint, and it is, as a rule, too light to give many copies before the sheet must be thrown away. The writer, after some experimenting, has made a darker tinted paper by mixing in other colors.

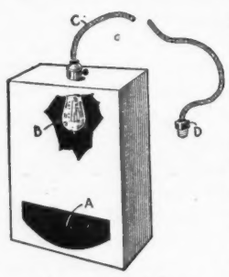
Take, for instance, blue or purple carbon paper. By mixing a quantity of carbon black with the blue a deeper tint is obtained, which makes a very strong copy. Purple is also improved by the addition of lamp-black. Purple color is obtained by mixing red and blue. The addition of lamp-black to purple makes a fine purple-black tint, which looks well and makes a fine copy.

Since the strength of colors bought in stores varies greatly, no proportions are given. It is better for the experimenter to mix a small quantity of the colors until a deep and satisfactory tint is obtained, and then to make up a sufficient quantity to coat the paper.

Take fine lamp-black or ivory-black, carmine, or ultramarine blue. Mix thoroughly with soft soap, and rub the mass, with the aid of a stiff brush, on thin but strong typewriter paper. By this method a far better copying paper is produced than that made by fatty oils.—W. S. STANDIFORD.

A Home-Made Dark Box for Printing Developing Paper

THE printing device shown in the illustration consists of a cardboard box without a bottom. A hole is cut in the side of the box at *A* to admit the frame and hand of the operator. A hole is cut in the center of the top for an electric globe. The globe *B* has a cord *C* and attachment plug *D* for making connections to an ordinary electric-light socket thus furnishing the light.



Cardboard box used for printing developing papers

In printing, the frame is thrust into the hole *A* face up, and the light turned on with the other hand for the proper amount of time.

Building Bridges Out of Old Railroad Rails

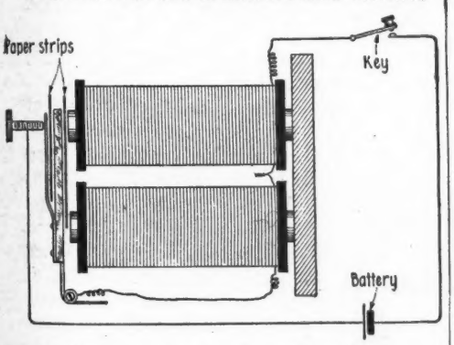
WHEN wood bridges wear out they should be replaced by structures of more durable material. One way of doing this is to build rough forms and pour concrete into them for the abutments. Make the span out of old rails instead of wooden beams. Such construction is substantial and also cheap; for rails can usually be bought for the price of scrap iron.

This is no easy job, however, and is very apt to be a failure if good engineers are not employed. Don't be stingy with the rails; the more used, the better the job. We see highway bridges with two or three I-beams used for the span, and are apt to think that the same number of rails will be enough. Though a rail is strong enough for the small span between railroad ties (8 to 14 inches), it is not as strong as commercial I-beams of the same weight. The relative strength can be found in any steel hand-book. For instance, a 7-in. I-beam weighing 45 pounds to the yard is as stiff as a rail weighing 80 pounds to the yard, which shows that the rail is almost twice as heavy as the beam of equal strength. The factor that represents the strength value is called the section modulus, and a hand-book will show it to be 10.4 for the beam and 10.1 for the rail.

Paper Strips on Armature Amplify a Buzzer Tone

WHEN making detector tests ordinary magnetic buzzers are generally used. Although quite convenient, the faint tone emitted is not as desirable a signal as could be wished for.

The tone can be raised by simply placing tightly folded strips of paper between the magnet core and armature and between the armature and contact



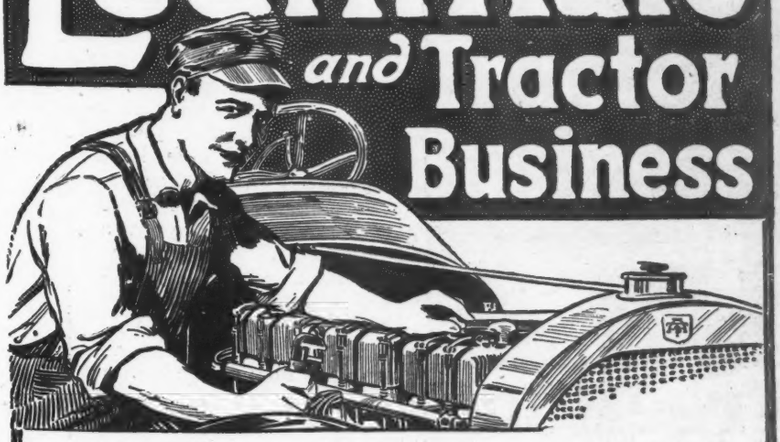
The paper strips are applied between the magnet core and the armature and contact spring

spring, as shown. The requisite thickness of paper may be determined by experiment.

Instead of the paper, rubber bands may be used, if they are wound tightly around the buzzer in such a manner as to occupy the same positions as the paper would.

In further adjusting the buzzer for a higher tone, the contact screw must also be regulated.

Learn Auto and Tractor Business



IMMENSE increase in production and use of Autos, Trucks, and Tractors, now that the war is over, coupled with the most urgent demand for Sales Agents and Motor Mechanics, makes this your greatest opportunity to qualify easily and quickly to make big money.

This is a Motor Age. Inter-Community Truck hauling, establishment of thousands of Rural Motor and Aviation Mail Routes, universal expansion of State and National Highways, general use of Farm Tractors for intensive cultivation, and on large acreages—will require greatly increased Maintenance and Repair Shop facilities.

Start a Repair Shop NOW!

There are 30,000 towns and rural communities, many of them on National Highways, without a garage or repair shop of any kind. Only a small investment required to get into the best paying business in nearly any community. Before you return home, we give you business as well as mechanical training in our own big garages, without extra cost.

Learn Here in 6 to 8 Weeks Earn $100 to $400 a Month

Every man, 16 years of age and over, who will apply himself, can learn here. We refer you to thousands of successful graduates, many of them right in your own section of the country, who have made good from the day they left here. No previous experience or educational requirements necessary to learn here.

Enormous Equipment The great Rahe School now has double equipment in every department as we recently took over the enormous quantity of up-to-date autos, trucks, tractors, block motors and electrical equipment used for training thousands of soldier mechanics in the Military Division of the Rahe School for Motor Division of U. S. Army, during war period.

Easy To Learn By The Rahe Practical Method

Daily work on this enormous up-to-date equipment under supervision of numerous Master Mechanic Instructors. Same training as used to qualify Soldier Mechanics in 60-day courses. Only additional cost to take your training at "World's Oldest and Greatest" Auto and Tractor School, is difference in carfare. No books used. No "Extras" to buy. Only Life Scholarships issued. **Plenty of opportunity to earn part living expenses while here.**

Special Tuition Rate Now! To help meet the incessant demand for Rahe trained men, we are making a special offer to those who come in the next thirty days. Send in the attached coupon at once for full particulars.

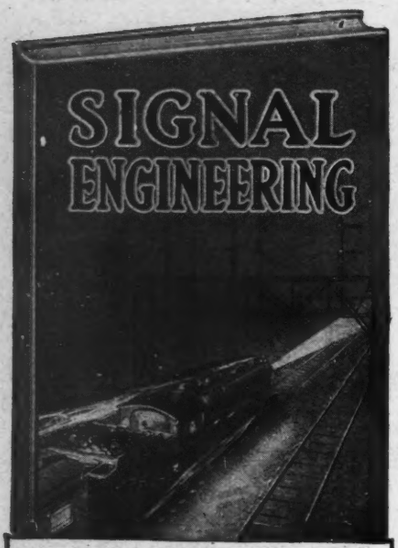
RAHE AUTO & TRACTOR SCHOOL
(Oldest and Greatest in the World)
2889 Oak Streets,
Kansas City, Missouri.

Mail This Coupon Today for FREE
7-Day Trial Offer, wonderful story of opportunities and big 64-page illustrated catalog

Name .....

Address .....

Age..... Occupation.....



FreeBook
on Signal Engineering

THOUSANDS of miles of railroad must be equipped with block signal systems. To superintend these installations and to maintain the systems now in use thousands of men are necessary. *Golden opportunities are now offered.* Every ambitious man should write for the free book on Signal Engineering.

If you join the army or navy before you have completed the course, further payments will be postponed until you return.

Men Are Needed!

At the present time, less than one-fourth of the passenger lines in the country are equipped with automatic block signal systems—and when you read that the day is fast coming when the law will compel railroads to install them, you will realize what remarkable opportunities are offered to ambitious men in the profession of Signal Engineering. The work is big—broad—high salaries are paid. $250.00 a month is an ordinary salary for a Signal Engineer. Write for particulars.

Send the Coupon

Put your name and address in the coupon, or a letter or post card *now* and get the free book about Signal Engineering. Too, we will tell you how you can get the training that you need in order to become a Signal Engineer. You will be under no obligation in writing for the book.

Department of Signaling, Dept. 1202, 1810 Wilson Ave., Ravenswood Station, Chicago, Ill.

Gentlemen:—Please send me absolutely free and prepaid your big new book on Signal Engineering. Also full particulars about your great special free outfit offer. It is distinctly understood that I assume no obligations of any kind.

Name.....

Address.....

Age.....Occupation.....

Department of Signaling, Dept. 1202, 1810 Wilson Ave., Ravenswood Station, Chicago, Ill.

Stronger, Clearer Voice for YOU!

Weakness, huskiness and harshness banished. Your voice given a wonderful strength, a wider range, an amazing clearness. This is done by the Feuchtinger Method, endorsed by leading European musicians, actors and speakers. *Use it in your own home.* Simple, silent exercises taken a few minutes daily impart vigor to the vocal organs and give a surpassing quality to the tones. Send for the facts and proofs.

Do You Stammer?

If you have any voice impediment this method will help you. You need not stammer or lisp—if you will follow our instructions. Mail coupon for free book.

WRITE!

Send the coupon and get our free book and literature. We will tell you just what this method is, how it is used and what it will do for you. No matter how hopeless your case may seem the Feuchtinger method will improve your voice 300 per cent. No obligation on you if you ask for this information. We gladly send it free, postage prepaid. Just mail the coupon.

Perfect Voice Institute
1772 Wilson Ave. Studio 1203 Chicago, Ill.

To Demagnetize a Watch Revolve It Near a Motor

VERY often an electrician, an engineer, or even a visitor to an electric light or power plant will discover after a few days that his watch is losing half an hour or more each day. This is because it has become magnetized by its proximity to the dynamos.

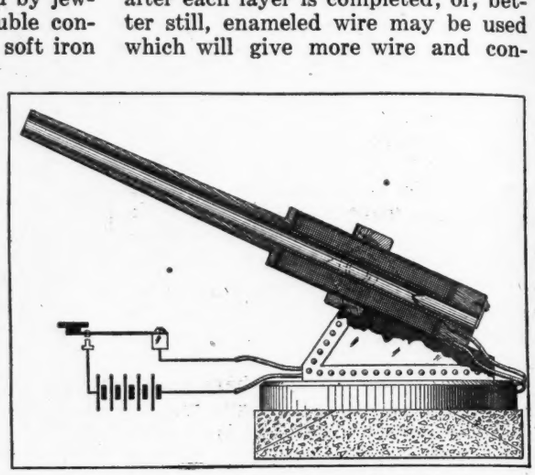
The regular apparatus used by jewelers for remedying this trouble consists of an elliptical piece of soft iron with a central hole large enough to permit the insertion of the watch. Over the iron core are wound a number of layers of fine insulated wires. Alternating current is sent through the wire. If there is no alternating current to be had, an additional device known as a polarity-changer must be used for direct current supply.

With a little trouble and no expense, any one may demagnetize his own watch by a similar method. Take a heavy thread or a light string about 2 ft. long, and tie the ring of the watch to it. Hold the string by one end and turn the watch around until the string is twisted for about 50 turns; then allow the string to unwind, and as the watch revolves pass it slowly back and forth about 2 in. above the fields of a small motor or dynamo while the machine is running. Care should be taken to keep the watch revolving constantly while it is held over the motor.—PETER J. M. CLUTE.

This Toy Gun's Projectile Is Driven by Electricity

A TOY gun, which is made of ⅛-in. brass pipe, makes use of the movement of an iron armature into the magnetic field of a solenoid when the current is applied. Mounted near the rear end of the pipe is a coil winding of the usual type. The proportions shown have been found effective. The gun can be made in any size desired so long as the proportions are kept. In order to give the appearance of a long-distance rifle, a wood sleeve is turned and pushed over the front end of the pipe and a wood part turned and pushed over the rear part.

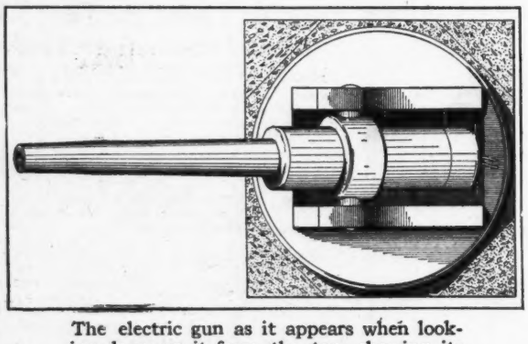
The coil is wound on the space thus made; but first an iron or steel washer is pushed over the pipe at each end of the coil space in order to strengthen the flux. The winding is arranged in even layers and shellacked after each layer is completed; or, better still, enameled wire may be used which will give more wire and consequently more strength to the coil.



A sectional view of the gun, showing the coil of wire around the firing-chamber and the projectile in place and a diagram of the telegraph-key and the battery circuit

When the winding is finished a piece of thin steel tubing is pushed over it, which bridges between the two washers, thus completing the magnetic circuit. If steel tubing, which is the best material, cannot be procured, a piece of thin tin may be wrapped around and soldered to form a tube, or else part of a tooth-powder box may be used. This iron casing is very important, as the strength of the gun will be greatly increased by its use. This tube is also used to support the gun. As the illustration shows, two brass hubs are turned and soldered to the steel tube and mounted in a wood carriage. In this way the elevation of the gun, which determines the range, may be controlled.

The projectiles consist of pieces of soft iron rods which are inserted at the rear and held in place by the hanging piece shown. The gun is fired by depressing the key which connects the battery, and releasing it again quickly. It is, of course, evident that the projectile tends to move to the center of the solenoid, and if the key is not released at the proper time, the projectile will either be drawn back into the gun or retarded in its flight. This fact introduces an element of skill into the firing of the gun.



The electric gun as it appears when looking down on it from the top, showing its mounting and base. The base is made of wood and decorated to represent concrete

Reaching the greatest range is, in all probability, the reason for the great fascination the gun has had for old folks as well as young.—CHARLES HORTON.

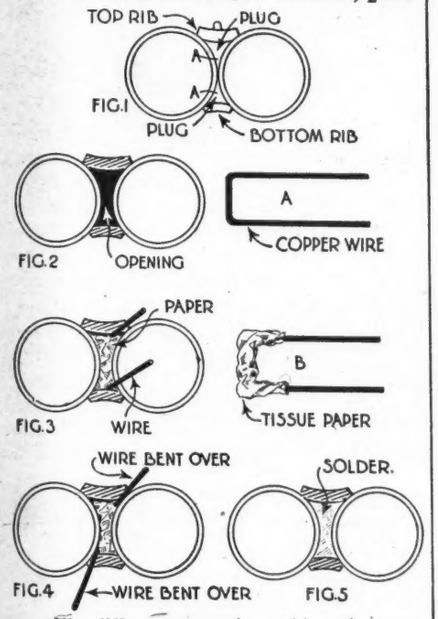
Locating a Projecting Nail in a Shoe by Flashlight

THE location and removal of a projecting nail from the inside of a shoe is usually accomplished only after much squinting and twisting so as to get sufficient light on the annoying nail, which is finally discovered and extracted by guesswork and the sense of touch. It is almost too simple to mention that the ordinary flashlight will illuminate the interior of the shoe or boot so well as to do away with the preliminary lost motion.—JAMES M. KANE.

Repairing the Crushed Ends of a Shotgun Barrel

THE accidental dropping of a railroad tie on the barrels of a gun obliged me to saw off about 6 in. of the barrels. The ends of the original barrels are shown in Fig. 1. In sawing off the barrels, an opening was left between the ribs (see Fig. 2).

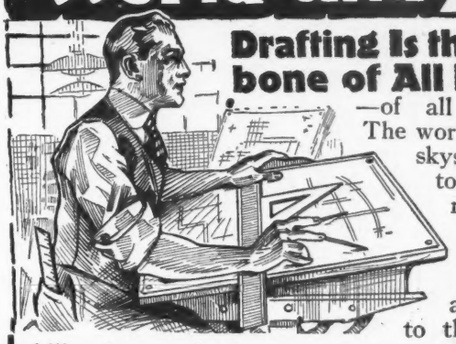
The channel between the barrels tapers from the breech toward the muzzle, being closed at the muzzle by the wedge-shaped plugs *A*. At the point where the section of the barrels was cut off, the channel was too wide for the original plugs, and I closed it with solder in the following manner: First I tinned the channel as far in as possible; then I made a loop of copper wire as at *A*. Around this I wrapped tissue paper, as at *B*. Pushing this in the channel, I pressed the paper so that it would fill the space Fig. 3, and then pulled the wires outward to bring the paper within ½ in.



The different stages in making the repair to the smashed gun-barrel

of the muzzle. Bending the wire as in Fig. 4, I filled the space with solder. After the solder had cooled I cut off the projecting wires and filed the end smooth, as shown in Fig. 5. The purpose of the paper was in order to make a base on which to build the solder.—JAMES M. KANE.

What Drafting Means to the World-and You



Drafting Is the Backbone of All Industry

—of all construction. The world—its homes, skyscrapers, factories, ships, railroads and commercial and industrial machinery are all monuments to the draftsman's skill. As a profession—as an avenue of advancement in every known form of engineering—drafting has no equal. Aim as high as you like and you can reach your mark in this greatest of all professions. Just as the reconstruction of Europe will first have to be planned on the drafting table, so has the world been built—so will the world continue to be built. That is why **there is no limit to your success** as a draftsman.

Draftsmen in Big Demand

Think for a minute of the colossal reconstruction plans of the United States to say nothing of Europe and you will get an idea of the busy years ahead for draftsmen in all branches. But there is always a big demand for draftsmen because they are fundamental factors in the world's progress.

Make Drafting Your Profession

The American School Home Study course will enable you to master this great, interesting and congenial profession without in any way interfering with your present work. Just give us a part of your **spare time** and we'll do the rest. Our lessons are simplified, well illustrated, easily understood—and we coach you carefully from the first lesson to the last. **You simply can't fail if you want to win.**

Satisfaction Guaranteed

DON'T HESITATE. Don't think you can't master our lessons by Home Study until you TRY. So sure are we that you can do as well as any of our thousands of students, we **Guarantee Satisfaction** or refund your money in full. That's how confident we are in our methods. Have you as much confidence in yourself? If so, check and mail the Coupon for FREE Bulletin.

Please Send Me Booklet and Tell Me How I Can Fit Myself for the Position Marked X

....Draftsman and Designer	....Lawyer
....High School Graduate	....Business Manager
....Electrical Engineer	....Certified Public Accountant
....Elec. Light & Power Supt.	....Accountant and Auditor
....Hydroelectric Engineer	....Bookkeeper
....Telephone Engineer	....Stenographer
....Telegraph Engineer	....Fire Insurance Expert
....Wireless Operator	....Sanitary Engineer
....Architect	....Master Plumber
....Building Contractor	....Heating and Vent. Engineer
....Civil Engineer	....Automobile Engineer
....Structural Engineer	....Automobile Repairman
....Mechanical Engineer	....Airplane Mechanic
....Shop Superintendent	....General Education Course
....Steam Engineer	....Common School Branches

Name .....

Address .....

American School of Correspondence, Dept. D-1202, Chicago, U. S. A.

American School of Correspondence
Dept. D-1202 Chicago, U. S. A.
TRAINING—THE KEY TO SUCCESS
ASC

Books for Mechanics

Sheet Metal Work—A manual of practical self-instruction in the art of pattern drafting and construction work in light and heavy-gauge metal, including skylights and roofing, cornice work, etc. Cloth, 288 pages, 370 illustrations. *Price*, $2.00, *Postpaid.*

Machine Shop Work—A comprehensive guide to the most approved methods in modern shop practice, the construction and use of improved tools and machines, hand tools, the lathe and lathe tools, the methods of screw cutting, taper and eccentric turning, etc. Leather, 275 pages, 325 illustrations. *Price*, $1.50, *Postpaid.*

POPULAR SCIENCE MONTHLY
225 West 39th Street New York City

Electrician's Wiring Manual

By F. F. SENGSTOCK

Electrical Inspector Chicago Board of Underwriters

Shows you how to proceed so that your work will pass the most exacting inspector. Every step explained in detail, made clear by 415 careful drawings.

Twenty-seven Chapters, 410 Pages, 415 Illustrations of Sound Practical Information. Flexible Leather Binding. Pocket Size.

Price $1.50 postpaid

POPULAR SCIENCE MONTHLY
225 W. 39th Street New York City

7 2¢/3 A DAY BUYS A GIBSON

Terms as low as $5.00 down and $2.30 per month. Mandolin or Guitar sent on approval. Liberal allowance on old instruments in exchange for the "Gibson." Get our new Free Book—112 pages, 111 illustrations. Valuable information for player and teacher. Explains wonderful new violin construction with carved and graduated Top and Back and Stradivarius Arching. Also free treatise on "How to Practice."

Teach and Sell the Gibson. Make $1800 to $5000 or More a Year

Become a teacher. Splendid opportunities for Mandolin and Guitar teachers—either sex, in every locality, for private and class instruction and sale of "Gibsons." They have "made" many a teacher professionally and financially. We have permanent teaching and business opportunity now open for either sex. Other positions pending. Write promptly. A. C. Brockmeyer, St. Louis, Mo., Teacher and Director, writes, "Will do $10,000 business in 1917; did $7,000 in 1916." Wm. Place, Jr., Providence, R. I., Star Soloist for Victor, unqualifiedly endorses the "Gibson."

Tenor Banjos

Most popular member of banjo family. Powerful, sweet tone, lively, "banjoistic" but musical—obtained by exclusive Gibson features. Great for dance playing or home. Play from any piano score—melody or chords—"straight or jass." Companion instrument: Gibson Guitar Banjo—fingerboard, stringing and tuning same as Guitar.

Do Business On Our Capital

Become our agent. We help sell. Agents' territory protected. Stock furnished. We pay the advertising. You make the profit. You pay for goods when sold; return goods not sold. Try our "Still Hunt." FREE to those interested our new $1.00 book "The Organization, Direction and Maintenance of the Mandolin Orchestra," by America's most successful director, Wm. Place, Jr. Write now for Catalog, Treatise, "How to practise; Psychologically Explained," all free. Don't wait; ACT NOW. FILL IN THE COUPON.

Gibson Mandolin-Guitar Co. 482 Parsons St., Kalamazoo, Michigan, U. S. A. Gentlemen:—Without obligation send me free book complete Catalog, free treatise; also information about the Wm. Place, Jr., book and instrument checked. If teacher check here ☐

☐ Mandolin ☐ Mando-cello ☐ Guitar
☐ Mandola ☐ Mando-bass ☐ Harp-guitar
☐ Tenor Banjo ☐ Guitar Banjo

Name.....
Address.....
Be sure you have instrument checked.

Gibson Mandolin-Guitar Co. 482 Parsons St. Kalamazoo, Michigan, U.S.A.

$1,000 Reward

Big rewards are frequently offered throughout the country—many are standing right now—for the catching of criminals. Finger print experts have the best chances of winning these great rewards. For the finger print system is the most reliable and effective means of identification known. You can be a finger print expert. Send the coupon and find out how you can master this new and fascinating profession in your spare time at home. Don't miss this big opportunity. Send coupon today and get our free book.

Be a Finger Print Expert! Not only in the police departments, but in government institutions, banks, railroads, insurance companies and other large industries, finger print systems are being installed under the guidance of finger print experts. You can earn from $25.00 to $50.00 a week. Right now there is an urgent, unfulfilled demand for experts.

FREE Book on Finger Prints

Send the coupon now for our valuable book telling all about finger prints and their uses; and about the big opportunities in the profession. It tells how you can learn in a short time at home. Special limited offer now. Get this free book and full particulars while it lasts. Send the coupon at once.

University of Applied Science
Desk 1202, 1772 Wilson Ave., Chicago

Please send me absolutely free and prepaid your new book on finger prints. Also particulars of your special limited offer. I assume no obligations whatever.

Name.....
Address.....
Age.....Occupation.....

Raise Belgian Hares

for us. Wonderful profits easily made at home. We furnish stock and pay you $6 a pair and express charges and buy all you raise. Also cavies and squabs.

Beautiful illustrated catalog and contract 10c

UNITED FOOD & FUR ASSOCIATION
329 West 48th St. Desk 4 New York

STUDENTS ART MAGAZINE Publishes cash art assignments, lessons and articles on Cartooning, Designing, Illustrating, Lettering, and Chalk-Talking. Criticises amateurs' work. Full of interesting and helpful information for artists and art students. Satisfactory or money refunded. 10 cents a copy, $1 a year.

Send $1 NOW, stamps or bill.

STUDENTS ART MAGAZINE, Dept. 417, Kalamazoo, Mich.

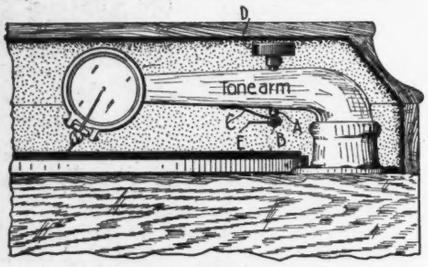
THE BOY ELECTRICIAN

Practical Plans of Electrical Apparatus for Work and Play with an Explanation of the Principles of Every-day Electricity. $2.00 *Postpaid*.

POPULAR SCIENCE MONTHLY, 225 W. 39th St., New York

An Electric Automatic Stop for the Phonograph

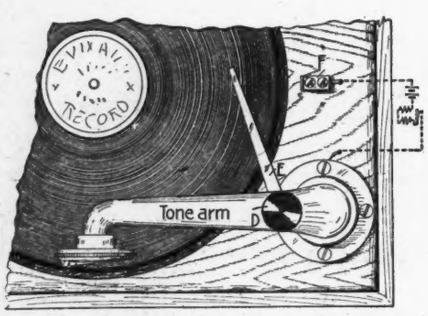
ONE of the disagreeable features of the ordinary phonograph is the necessity for leaving one's seat before the end of a selection to turn off the motor. This produces a nervous strain in the person who is operating the machine, with the result that he cannot enjoy the music. The writer experienced this, and being a music lover devised a method of automatically shutting off the machine.



The shaft with the knob run through the tone-arm for setting the finger at the right point on the record being used

The method proved simple and entirely reliable. Reference to the accompanying illustration will show how the apparatus is constructed. There is inserted through the usual tone arm a piece of brass tube *A* in which fits a rod *B* that freely rotates therein and is held under friction by the spring *C* soldered or screwed to the tone arm. A knurled knob *D* is mounted at the upper end of the rod *B* and secured with a set screw, and the arm *E* of flat brass is secured to the bottom of the rod between two lock-nuts. A flat contact *F* is secured to the floor of the cabinet, and extends upward sufficiently to be in the path of the arm *E*, serving to make contact therewith.

The operation of this part of the device is obvious. Before starting the record, the needle is set in the next to the last groove near the center or thereabout and the knurled knob is used to set the contact arm *E* against the contact *F*. The friction spring *C* then holds the arm in this position while the reproducer is lifted and the needle started in the first groove of the record. It is obvious, then, that when the record is about completed the tone arm will have moved over, bringing the contact arm close to the stop, thus making an electric contact.



The tone-arm carries a finger that makes [electrical contact at the end of the record]

The rest of the apparatus cannot be shown, because it depends on the type of the machine used. It consists, however, of an electric bell, the bell and hammer of which have been removed, leaving just enough of the hammer to be bent at right angles to form a hook. The stopping lever is then provided with a spring which tends to keep it in the stopped position, and the hook of the bell is arranged to catch and hold it in the running position when the machine is started. Thus, when the contact is made at the conclusion of the record, the bell magnets will be energized and will pull the restraining catch away from the stop lever, allowing the spring to pull the stop lever to the stop position.

There are several refinements that suggest themselves for the apparatus. For instance, the author arranged a flexible cord with a pear-shaped push connecting one wire to the tone arm and the other to the contact spring, so that he could stop the machine at any time during the rendition of the selection, as for instance when visitors entered the room who were to be introduced. Another refinement which occurred to the author, but which he did not make use of, consisted in attaching a semicircular scale with numbers to the tone arm and allowing the contact arm to play over it. Then each record should be played and the exact position of the tone arm noted, which will bring the machine to rest immediately when the music stops and the corresponding scale number marked on the record at the center, so that it will not be necessary to set the contact arm for any record.—CHARLES HORTON.

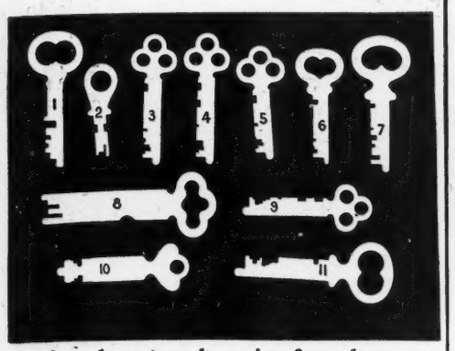
Locating Keyways on Direct-Connected Machines

IT is often necessary for two machines whose rotating elements are mounted on the same shaft, or are to run direct connected, to operate in series or parallel. In this instance, the generator voltages should be in phase with each other, and to accomplish this the keyways of the two machines should be definitely located with respect to each other. This is done by connecting the fields of both machines in series to the same source of power. The rotating parts are then adjusted, and the keyways so located that with a sudden opening of the field switch no kick is noticed on a voltmeter connected across any phase of either machine.

The position is best determined as follows: Set the rotating and stationary elements of one machine with respect to the other, so that no voltmeter kick is obtained across any particular phase when the field circuit is suddenly opened. Then set the second machine so that no kick is obtained across that phase which is to be connected to the phase of the machine on which the kick was registered. A mark should be made on the machine and shaft, for the keyway location.

Keeping a Record of Flat Keys on Photographic Paper

THE illustration is a shadowgraph of flat keys made by the use of gaslight paper, such as is used for making prints from photographic negatives. The paper is placed on top of the keys after they are placed on the



A good way to make copies of your keys, so they may be duplicated in case of loss

glass in the printing-frame. They are exposed to the paper the same as for gaslight printing. A little experimenting will make certain the proper exposure. Developing is done in the usual manner.

This shadowgraph can be used as a negative, and a number of prints made from it. It is often desirable to have such a record of keys. In case of the loss of a key-ring the keys can be replaced easily. A locksmith can make new keys from the key record.

In clubs and schools and factories where a great many steel lockers are used, and where the percentage of lost keys is very great, such prints would obviate the necessity of keeping on hand a large and expensive supply of duplicates, and would make it unnecessary to keep in communication with the manufacturers of the lockers to replace the lost keys.

Reference numbers or letters or a code of signs could be used on the print to record the locks to which they belong.—HERMAN G. GILBERT.

How to Make Good Mercury Electrical Connections

PERFECT electrical connections are often made by dipping the ends of copper wire into cups of mercury. The process usually employed is as follows:

Pour some nitric acid into a bottle having a glass stopper, and add a few drops of mercury, thus forming nitrate of mercury. In the preparation of this compound there should be a slight excess of mercury. Clean the copper wire and dip the end for a moment into the liquid. Upon withdrawal the wire will appear blackened, but if wiped off briskly with a cloth it will be found brightly amalgamated.

The simple test for perfect amalgamation is that the extremity of the wire should be able to raise a small drop of mercury from the table.—PETER J. M. CLUTE.

Foremen and Superintendents $1800 to $5000 Yearly
Engineers (all kinds) $2000 to $5000 Yearly
Office Manager or Auditor $1800 to $5000 Yearly

Learn to Fill Bigger Shoes

NO matter what kind of work you are doing now, a set of these great home study books will quickly fit you for a bigger and better paying job. We will send any set you select for one week's FREE examination, and if you want to keep them you pay only the special reduced price—at the rate of 50 cents a week. This is your opportunity to make more money—grasp it NOW. Use these books and a little spare time AND LEARN TO FILL BIGGER SHOES.

Carpentry and Contracting
Five volumes, 2138 pages and more than 400 illustrations. Prepares for Contractor, Building Superintendent and Carpenter Foreman. Regular price, $25.00. Special price, $17.80.

Civil Engineering
Nine volumes, 3900 pages and 3000 illustrations, plates and diagrams. Prepares for Civil or Structural Engineer, Transitman, Estimator, Designer or Chief Draftsman. Regular price, $45.00. Special price, $29.80.

Telephony and Telegraphy
Four volumes, 1728 pages and 2000 illustrations, plates and diagrams. Prepares for Telephone Engineer, Wire Chief, Exchange Manager, Trouble Man or Telegrapher. Regular price, $20.00. Special price, $12.80.

Steam and Gas Engineering
Seven volumes, 3300 pages and 2500 illustrations, plates, diagrams, etc. Prepares for Stationary, Marine or Locomotive Engineer or Fireman. Regular price, $35.00. Special price, $21.80.

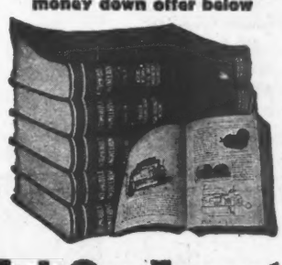
Law and Practice
(with Reading Course in 25 bound pamphlets). Thirteen volumes, 6000 pages and 24 illustrations. Prepares for all Bar Examinations. A wonderful aid to business men. Regular price, $72.00. Special price, $39.80.

Practical Accounting
Four volumes, 1840 pages and 800 illustrations, plates and diagrams. C. P. A. questions and practical problems. Prepares for Accountant, Bookkeeper or Cost Clerk. Regular price, $20.00. Special price, $12.80.

Pay Raisers

These books are written by well known authorities—the top-notchers in each line. They will help you make more money. You can't fail to understand them, because they are written in plain, everyday language. Thousands of photographs, diagrams, charts, etc., help to make difficult points as simple as A-B-C.

See our Free Examination—no money down offer below



Ask Our Experts

With these books goes free of all charge a $12.00 Consulting Membership in the American Technical Society. If any question puzzles you—write us. Our corps of experts and engineers will solve any problem. Ask all the questions you want for a whole year. This service is absolutely FREE.

Automobile Engineering
Five volumes, 2400 pages and 2000 illustrations. Prepares for Garage Foreman, Automobile Mechanic or Chauffeur. Invaluable to car owners. Regular price, $25.00. Special price, $17.80.

Machine Shop Practice
Six volumes, 2300 pages and 2500 illustrations. Prepares for Machine Shop Superintendent or Foreman, Foundryman, Pattern Maker, Tool Designer or Tool Maker. Regular price, $30.00. Special price, $19.80.

Sanitary, Heating and Ventilating Engin'ring
Four volumes, 1454 pages and more than 1400 illustrations, etc. Prepares for Sanitary Engineer, Heating and Ventilating Engineer, Master Plumber or Plumber. Regular price, $20.00. Special price, $13.80.

Mechanical and Architectural Drawing
Four volumes, 1578 pages and more than one thousand illustrations. Prepares for Architectural or Mechanical Draftsman. Regular price, $20.00. Special price, only $14.80.

Electrical Engineering
Seven volumes, 3000 pages and 2000 illustrations, plates and diagrams. Prepares for Electrical Engineer, Power Plant Superintendent, Substation Operator or Electrician. Regular price, $35.00. Special price, $19.80.

Accountancy and Business Management
Ten volumes, 3680 pages and 1987 illustrations, forms, etc. Prepares for Certified Public Accountant, Auditor, Office Manager, Accountant, Credit Man or Bookkeeper. Regular price, $50.00. Special price, $24.80.

DON'T SEND ANY MONEY!

Write the name of the books you want on the coupon and mail it today. We will send the books at once, express collect, and you can use them just as if they were your own for a whole week. If you decide you don't want to keep them, send them back at our expense. If you like the books, as thousands of other men have after examination, just send us $2.00. You can send the balance of the special reduced price the same way—$2.00 each month (50 cents a week).

Start right now and learn to fill bigger shoes. There will be a better job looking for you if you do. Be ready to meet it when it comes. *Send the coupon now.*

American Technical Society, Dept. X1202, Chicago, Ill.

American Technical Society, Dept. X1202, Chicago, Illinois

Please send me set of _____ for 7 days' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2 within 7 days and $2 each month until I have paid the special price of _____. If I decide not to keep the books, I will return them by express at your expense. Title not to pass to me until the set is fully paid for.

Name _____

Address _____

Reference _____

SEND THE COUPON NOW

SAVE YOUR BODY

Conserve Your Health and Efficiency First

"I Would Not Part with it for $10,000"

So writes an enthusiastic, grateful customer. "Worth more than a farm," says another. In like manner testify over 100,000 people who have worn it.

THE NATURAL BODY BRACE

Overcomes **WEAKNESS** and **ORGANIC AILMENTS** of **WOMEN** and **MEN.** Develops **erect,** graceful figure. Brings restful relief, comfort, ability to do things, health and strength.

Wear It 30 Days Free at Our Expense

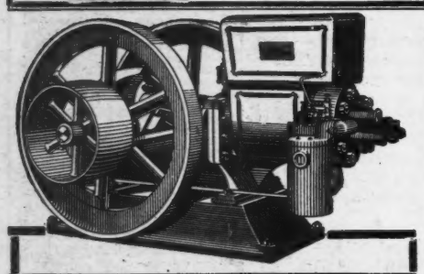
Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation. Comfortable and easy to wear.

Keep Yourself Fit

Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

HOWARD C. RASH
Pres. Natural Body Brace Co.
241 Rash Building SALINA, KANSAS

For Boys and Girls Also



OTTAWA ENGINES

Kerosene Oil, Gasoline and Gas

Let me send you an engine to earn its own cost while you use it—for my Kerosene engine gives more power from a gallon of 12-cent kerosene than you can get from a gallon of 20- or 25-cent gasoline in a gasoline engine—Easy to start; easy to operate; no cranking; no batteries. All sizes—2 H.P. to 22 H.P.—Stationary, Portable, and Sawing Outfits. **10-Year Guarantee on Every Engine.** *Write for Latest Prices.*

DIRECT FROM MY BIG FACTORY

Ever since I started my factory, years ago, I have been selling engines direct from the factory to the man in the shop or on the farm. Now, as before, any honest man can have my **90 Days' Trial** Every engine I send out engine on must make good all I guarantee. No need to pay double my price for any good engine, or take an out-of-date engine for any kind of a price. Let me show you how to figure what an engine is worth and

How to Know Better Engines

My newest book helps you choose a safe and value-received engine—How to make simple tests—and all about valve in head motor. Send me your address today. Just a postal card will bring this newest and latest book.

GEO. E. LONG. **OTTAWA MFG. CO.** 1950 King Street OTTAWA, KANS.

Why Pay Full Prices for Diamonds

Write Today for Special Bargain Bulletin

DIAMOND Banking is the business of a million dollar firm nearly 3/4 century old. *We lend money,* accepting high-grade diamonds, etc., as security. When loans remain unpaid we must sell to get our money. Most amazing bargains proved by customers' letters. Diamonds, Rings, Pins, Brooches, Pendants, etc., at prices we challenge you to match at 60 per cent more, sent for absolutely free examination.

Write for JOS. DeRoy Bulletin

Radically different from ordinary catalogs. Send your name today and we will send you our bulletin of bargains showing hundreds of unpaid loans. It is absolutely free.

Jos. DeRoy & Sons 4747 DeRoy Building
Only Opposite Post Office Pittsburg, Pa.

6%

For nearly a quarter of a century

we have paid 6% on Time Certificates, issued for $100 or more, and have never been a day late in mailing checks for semi-annual interest or withdrawals.

For 16 years we have paid 5% on Certificates issued for $25 or more and **payable on demand.**

Our Certificates are amply protected by first mortgage on improved real estate in which all our investments are made.

Booklet gives full information—write for it.

The Calvert Mortgage Company
869 Calvert Building Baltimore, Md.

$1 A WEEK PAYS FOR THE Black Beauty

Send no money. See wheel first.

Don't buy an ordinary bicycle. Get a Black Beauty — factory-direct: **wholesale price.** Built for fellows who want a sensational wheel. Snappiest, raciest, strongest "Bike" in all cycledom.

18 Exclusive Features

See the wheel itself. Any one of *20 styles* shipped absolutely at our risk. No advance money. Keep or return. **We pay freight.** *Months* to pay if you decide to keep it. Small amount on acceptance, then $1 a week.

Guar. 5 yrs. Greatest offer ever made!

HAVERFORD CYCLE CO.
(Est. 23 yrs.) Dept. G50 Philadelphia

FREE Beautiful New 1919 Catalog in colors

ARMATURE AND MAGNET WINDING

By Horstmann & Tousley

A necessary book for Electricians. Full facts and diagrams, $1.50 postpaid.

Popular Science Monthly, 225 W. 39th St. N. Y.

Telegraph Pictures

BY ELECTRICITY

A complete set of two machines of this marvelous equipment for only $19.50. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Picture telegraphing is the coming science. Write today.

L. J. LEISHMAN CO., Dept. H, Ogden, Utah

TYPEWRITER SENSATION

$3 or $4 monthly buys a Beautifully Reconstructed Latest Model Visible Typewriter with back-spacer, decimal tabulator, two-color ribbon, etc. Every late style feature and modern operating convenience. Perfect appearance, perfect action and absolute dependability. Sent anywhere on approval. Catalog and special price FREE.

Harry A. Smith, 306, 218 N. Wells St., Chicago, Ill.

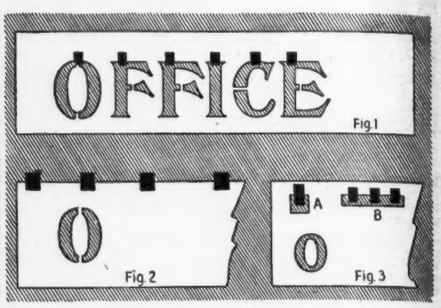
THE BOY ELECTRICIAN

Practical Plans of Electrical Apparatus for Work and Play with an Explanation of the Principles of Every-day Electricity. $2.00 *Postpaid.*

POPULAR SCIENCE MONTHLY; 225 W. 39th St., New York

Method of Attaching Stencils to Smooth Surfaces

DUPLICATION of design or inscription is always accomplished with more neatness, accuracy, and much more rapidity with the aid of a pounce, transfer, or stencil. The demand for this mechanical aid is almost imperative if the work is to appear in parallel.



Strips of tape are used for attaching the letters in position on the surface to receive the sign

With the use of a stencil and moist colors it is absolutely necessary to keep the stencil in accurate register. Unless the painter has the aid of a helper to hold the stencil in position he must hold it with one hand or fasten it to the surface on which it is to be placed.

Metal, glass and varnished surfaces cause the stencil to slip unexpectedly; and when using a stencil on any of these it is a difficult operation for one man, unless the stencil is small. If it has considerable weight or is of large dimensions it is decidedly a two-man job.

Having occasion to use a large stencil on the varnished panels of an automobile truck it occurred to me to try adhesive plaster or surgical tape as a means of holding the stencil. I used it with very satisfactory results. Its adhesive qualities and strength are well known, and its flexibility adapts it to almost any situation. It will not deface the surface and the traces of the stickiness it leaves can be easily removed with turpentine, oil, gasoline or alcohol. It can even be painted over if advisable.

Three methods of using are shown in the illustration, in which Fig. 1 shows strips of tape applied to the surface of the stencil just above the letters, and retaining it by adhering to the surface just inside the tops of the letters.

To remove the stencil, carefully pull off each strip of tape from the paper toward the letter, moving the stencil outward as if rolling up. Dampen a bit of cotton or cloth with turpentine or oil and clean off the traces of adhesive. Always begin as close to the margin edge of the letter as possible, rubbing from the outer edge toward the center, then carefully paint in the space cleaned.

In Fig. 2 is shown the method of working on glass. In this case the strips of tape project uniformly over the upper margin of the stencil and

adhere to the glass. If the stencil is properly taped it can be lifted off the surface like a lid, the strips of tape acting as hinges. Removing the stickiness from glass or metal is easily accomplished with gasoline or alcohol.

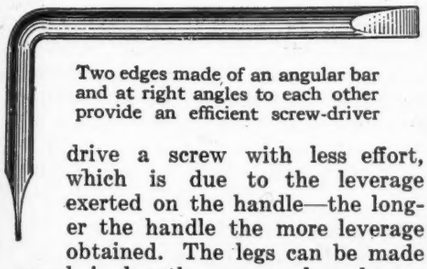
In Fig. 3 is shown still another method which may be occasionally used to advantage when working on glass or metal. In Fig. 1 and 3 a heavy stencil may sag a bit, but the application of a second piece of tape over the first at the point of weakness usually corrects the trouble.

It is hardly necessary to say that the tape merely holds the stencil in register. Portions of the stencil showing a tendency to rise must be held down while working on that particular space. This method of holding a stencil is very handy when the stencil is to be bent around a corner or applied to a circular form. As a precaution it is well to look over the tape occasionally, for while it withstands quite a bit of heat, the surface being worked on may become so warm that it will soften the adhesive enough to weaken it so that it will no longer hold.—JAMES M. KANE.

A Double-End Screw-Driver for Close Work

A VERY convenient form of screw-driver, and one that every workman should have in his tool-kit, is made by bending a 3/8-in. round rod of tool-steel to right angles and grinding the ends flat to fit the slot in the screw. It is best to have the edges on each part of the bar ground at right angles to each other, as shown in the illustration.

This enables the user of the instrument to get another hold on a screw by using the other end of the tool when working in a position where there is not much space to use the ordinary screw-driver. With this tool the user can



Two edges made of an angular bar and at right angles to each other provide an efficient screw-driver

drive a screw with less effort, which is due to the leverage exerted on the handle—the longer the handle the more leverage obtained. The legs can be made equal in length, or one leg shorter than the other.

After grinding the edges, heat each one to a cherry-red color, and plunge the beveled part into water, leaving the part above it hot. While this part is still hot, rub one of the hardened edges bright with a file, and watch the colors as they extend from the heated part toward the edge. When a light purple color reaches the edge, plunge it into water until it is cold. The reason for lowering the temper of the edge is to prevent the latter from breaking out when the screw-driver is being used.—W. S. STANDIFORD.

WANTED

$175 to $250 a Month!

DRAFTSMEN are needed now more than ever. Thousands of high grade draftsmen and designers are in demand. Answer the call. This is your opportunity to get started in a profession that pays straight salaries of from $175 to $250 a month. I can train you in a short time to fill one of these big positions if you write to me at once. Every industry needs draftsmen badly right now. Under my personal training you can easily qualfy. Send the coupon below for my new book on drafting—it's Free.

Learn Drafting—Fill Jobs

You who have been waiting to get out of the rut—open the door and come on in. You can have these jobs. You can make this money. I have been training draftsmen for 25 years. I know what they need quick to fill the very jobs open. Mail the coupon below for valuable book explaining how *you* can become a skilled, high priced draftsman in a short time and get the experience required. This book is FREE at present. Send for it TODAY.

Chief Draftsman Will Train You Personally

on practical work. Here is an opportunity for a limited and selected number of ambitious men to receive individual training. As Chief Draftsman of a large and old established Company I have trained on practical home study work hundreds of men who are now drawing the highest top notch salaries. At present I can accept a few more to be trained by me personally **until competent** and until they have experience to hold a position as first class draftsman.

Drawing Table Also FREE

In order to train you on regular draftsman's work to get practical working experience, I give you besides all the working tools also FREE a regular adjustable drafting table if I accept you as my student, the same table that I use myself.

This $15 Draftsmans Working Outfit Free!

Because of the urgent demand for more and better men in the drafting field I will give absolutely FREE this $15.00 Drafting Outfit to students who enroll right away. I know exactly the quality and kind of practical training and experience necessary to obtain and fill the highest paid positions. This is not a regular correspondence school course.

Mail Coupon at Once

Because I can handle only a limited number of students to give each the proper and practical training. Therefore, if you write AT ONCE I will consider accepting you as my personal student to train you on regular drafting room work that will give you the experience that is demanded. What I want is the right kind of men and I charge only a nominal price for training you that you can pay on very easy terms. My object is to develop experienced draftsmen, because they are badly needed right now and for the next twenty-five years to come. Send the coupon today—now. Address

Chief Draftsman DOBE

Engineer's Equipment Co.—Div. 1202 —Chicago, Ill.

FREE BOOK OFFER COUPON

Chief Draftsman DOBE
Engineer's Equipment Co.
Div. 1202 Chicago, Ill.

Without any obligation, please mail your book "Successful Draftsmanship" and full particulars of your liberal "Personal Instruction" offer. Also tell me how I can get the training to hold a high salaried position in the department I have checked below.

☐ Mechanical ☐ Ship Drafting ☐ Architectural

Name.....

Address.....

Play it a week on free trial

You may have your choice of more than 2,000 instruments for a week's trial in your own home. Play it as if it were your own. Then, if you wish, you may send it back at our expense. Trial does not cost you a penny. Don't miss this big offer.

WURLITZER
One hundred and fifty years of instrument making

Convenient Monthly Payments

If you decide to buy you may pay the low manufacturer's price at the rate of a few cents a day. The name "*Wurlitzer*" has stood for the highest quality for nearly two centuries. Every known musical instrument sold to you at direct-from-the manufacturer's price. We've supplied U. S. Gov't with trumpets for 55 years.

Send the Coupon! Just put your name and address on the coupon now. Please state what instrument you are interested in. There is no obligation. We will send you the big 160-page book free and prepaid. Send coupon now!

The Rudolph Wurlitzer Co. (Dept. 9202) East Fourth St., Cincinnati, O. S. Wabash Ave., Chicago, Ill.

The Rudolph Wurlitzer Co.
Dept. 9202
E. 4th Street, Cincinnati, Ohio
S. Wabash Avenue, Chicago, Ill.

Gentlemen:—Please send me your 160-page catalog, absolutely free. Also tell about your special offer direct from the manufacturer.

Name.....

Address.....

I am interested in.....
(Name of Instrument here)

Get Your Farm Home from the Canadian Pacific

THE Canadian Pacific Railway offers you the most wonderful opportunity in the world to own a farm in Western Canada. It will sell you land for $11 to $30 an acre or $50 an acre under irrigation.

20 Years to Pay

You pay down 10% of the purchase price and have twenty years to pay in full at 6% interest.

$2,000 Loan to Farmers

The Canadian Pacific Railway will loan to approved settlers on its irrigated lands up to $2,000 in improvements with twenty years to pay back the loan at 6% interest.

Land Under Irrigation

In Southern Alberta, we have developed the largest irrigation undertaking on the Continent. This district consists of some of the best land in Western Canada. An unfailing water supply is administered under direction of the Canadian Government—no conflict of law or authority over its use. This land is offered on same easy-payment terms as other lands. Prices ranging up to $50 an acre.

This Is Your Opportunity

To make investigation easy, special railway rates have been arranged. Write for particulars and free illustrated booklets.

M. E. THORNTON
Supt. of Colonization
Canadian Pacific Railway
925 First St., E., Calgary, Alberta

Spare Time Work
with Popular Science Monthly

Hundreds of active men are working for POPULAR SCIENCE MONTHLY in their spare time. POPULAR SCIENCE MONTHLY is growing so fast that it has opportunities for additional men in communities all over the country.

Can you arrange to give an hour a day, or one day a week, or one evening a week? The plan can be adapted to your time. Now is the time to apply.

Popular Science Monthly
225 West 39th Street, New York

Electrical Devices and How They Work

XIV.—Lightning-Arresters

By Peter J. M. Clute, B. E.

SO-CALLED lightning-arresters do not always stop the action and effects of lightning. They do, however, afford ample protection or insurance against damage to electrical devices. The general term "lightning protection equipment" applies not only to lightning-arresters, but also to other devices that serve to minimize damage by lightning to electrical apparatus.

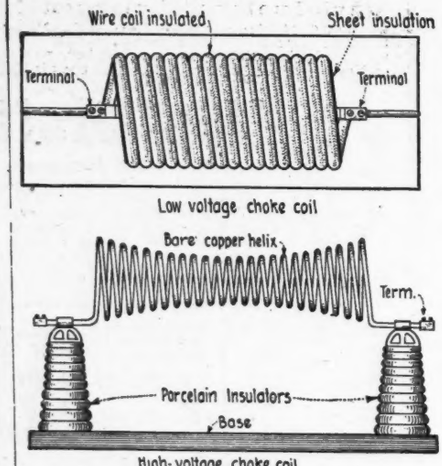


Figure 1

Large and small choke-coils used to increase the inductance of a circuit

The term "lightning" applies to any excessively high voltage disturbance in an electrical generation, transmission, or distribution system. Commercial lightning-arresters protect only against the effects of transient abnormal line voltages. They are not, as a rule, designed to minimize the effects of continued abnormally high voltages, regardless of how such high voltages may originate.

Two Kinds of Lightning

Lightning is divided into two general classes: atmospheric lightning and internal lightning. The equalization of a potential difference between two clouds oppositely electrified, or between a cloud and the earth, causes atmospheric lightning. Visible manifestations of such lightning phenomena are seen in lightning strokes and flashes. This class of lightning may affect an electrical system either directly or indirectly.

Arresters, as a rule, are incapable of affording absolute protection against direct strokes. If the current of a direct stroke passes through a lightning-arrester, that arrester is usually destroyed. When an excessively high potential is induced on an electrical system by an atmospheric lightning discharge, it is called an indirect or induced stroke. With the commercial forms of arresters, protection against the effects of induced strokes is satisfactory.

What Causes Surges

Surges, or internal lightning effects, are excessive voltage rises coming from changes in the load on the electrical system. Such abnormal conditions may, for example, occur on high potential systems, and may be caused by the opening or closing of switches or by an intermittent ground. The use of the arrester on an electrical system is to relieve the circuit of abnormally high voltages, as a pop-safety valve acts under excessive pressure in a steam-boiler. Any device that will, under abnormal voltage, permit current to flow through it to ground, and that will, when such condition ceases, stop the flow of that current, constitutes a lightning-arrester.

Lightning-discharge currents are always of high frequencies, or the equivalent thereof. They are oscillary in character; that is, the current surges back and forth thousands of times a second, and a coil of wire, called a choke-coil, has an apparent resistance that is enormously greater for such an oscillary current than for a steady, direct one. The excess resistance that such a coil offers to an alternating as compared with a direct current is due to the self-induction of the coil.

For a given coil and a given flux density, the inductance is constant; but the apparent resistance opposing the current increases rapidly as the number of alternations of the current increases per second—that is, the higher the frequency the greater will be the so-called apparent resistance of the conductor.

Large and small capacity choke-coils are shown in Fig. 1. In a general way, the protective capacity of a choke-coil increases as the square of the mean diameter of the coil. With coils of equal mean diameter and length, the protection afforded varies as the square of the number of turns. The function of a choke-coil in lightning protection is to increase the inductance of the circuit in which it is inserted,

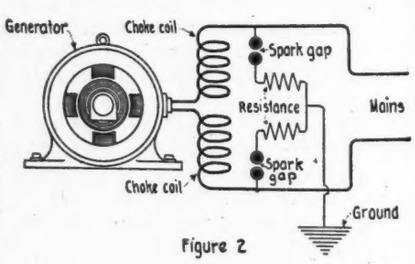


Figure 2

Choke-coils placed in a circuit so that they will tend to force the lightning to ground

as is indicated in Fig. 2. It thereby has a tendency to force the lightning-discharge currents to ground through the lightning-arrester. Hence, unless choke-coils, which are especially designed to provide inductance, are

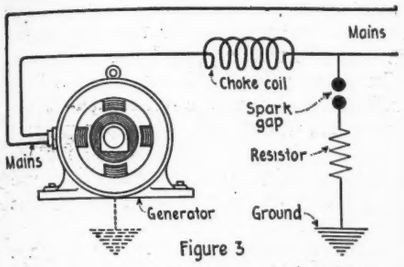


Figure 3

An air gap, to protect machinery from abnormal discharges of electricity

placed in the line circuit as shown, abnormal voltages may be induced in the windings of the apparatus and cause an insulation breakdown.

Where There Is No Protection

Referring to the diagram Fig. 3, assume that, due to one cause or another, an abnormally high voltage exists between the line and the ground. This voltage would have a tendency to force a current from the line to the earth, selecting the path of least resistance. With no protective apparatus in the line, this path would prob-

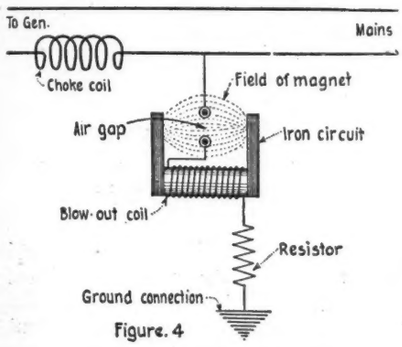


Figure. 4

A magnetic blow-out, to be used on direct-current machines

ably be through the windings to the machine frame and thence to ground. In seeking ground by this path, the abnormal voltage would break down the winding insulation, thus damaging the machine considerably.

If, as in the diagram Fig. 3, an air gap were connected between the line and the ground, the path through the gap to the earth would probably offer far less opposition to the flow of lightning-discharge current than would the path to ground through the machine. This is due to the fact that the path through the air gap to the ground would have practically no inductance, whereas the path through the machine and choke-coil would be one of relatively high inductance.

For Direct-Current Circuits

Arresters for direct-current circuits are different in design from those for use on alternating-current systems,

Where Woman's Service Looms Large

War gave woman her supreme and glorious opportunity to enlarge her field of service. She won her share of the laurels for patriotic achievement.

With exalted aim and unflagging zeal she figured in practically every activity that made for victory and the relief of distress. She plied the needles that fashioned comforts for our soldiers. She ministered to the wounded. She labored unceasingly in canteen work.

She has kept the wheels of industry going; tilling the soil; bending over bench and lathe. In counting house and chemical laboratory she has loaned her brains to the cause.

In telephone service, also, a host of capable, loyal daughters of America still find expression for their ambition and ability. These girls are privileged to play an indispensable part in the nation's welfare. They have in their keeping the myriad avenues of telephone communication through which the nation's industry is guided.

The Bell System invites enlistment among its ranks of loyal operators.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

CLASS PINS-RINGS
DIRECT FROM FACTORY TO YOU
OUR NEW CATALOG WITH 600 OF THE LATEST UP-TO-DATE DESIGNS FREE.
C. K. GROUSE CO.
12 Bruce Ave., North Attleboro, Mass.

FREE · Lintex · REVERSIBLE
Try one of these money saving collars *at our expense.* State size wanted on postal.
REVERSIBLE COLLAR CO., Dept. A Boston, Mass.

"Say it with Flowers"

FOR GIFTS

Patronize your local florist. Flowers not only delight the eye, but their beauty and fragrance brighten the atmosphere.

Your local florist, within a few hours, can deliver fresh flowers in any city or town in the United States and Canada through the Florists' Telegraph Delivery service.

DRAWING

Big Pay—Easy Pleasant Work

Draftsman earn $150.00 to $300.00 a month. The work is pleasant and the hours are short.

You can get this big pay too. All you need is the new 1919 edition of the Cyclopedia of Drawing and a little of your spare time. The cost is only 7 cents a day, and we give a year's consulting service free. See the FREE examination offer below.

Cyclopedia of DRAWING

4 big volumes each 6¼x8¼ in., bound in genuine American Morocco and trimmed in gold 1678 pages and more than 1000 illustrations plates, diagrams and blue prints.

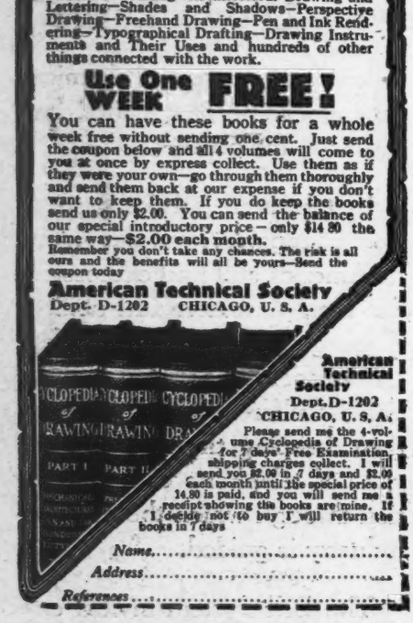
The only books that thoroughly cover Mechanical, Structural and Architectural Drafting in a non-technical way. You don't have to know anything about the subject to understand them. They begin at the beginning and tell you everything about Blue print Reading—Mechanical Drawing—Machine Design—Machine Drawing—Structural Drafting—Architectural Drawing and Lettering—Shades and Shadows—Perspective Drawing—Freehand Drawing—Pen and Ink Rendering—Typographical Drafting—Drawing Instruments and Their Uses and hundreds of other things connected with the work.

Use One WEEK FREE!

You can have these books for a whole week free without sending one cent. Just send the coupon below and all 4 volumes will come to you at once by express collect. Use them as if they were your own—go through them thoroughly and send them back at our expense if you don't want to keep them. If you do keep the books send us only $2.00. You can send the balance of our special introductory price—only $14.80 the same way—$2.00 each month.

Remember you don't take any chances. The risk is all ours and the benefits will all be yours—Send the coupon today

American Technical Society
Dept. D-1202 CHICAGO, U. S. A.



American Technical Society
Dept. D-1202
CHICAGO, U. S. A.

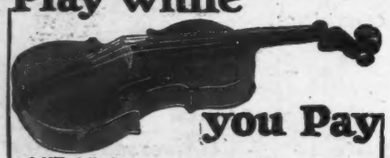
Please send me the 4-volume Cyclopedia of Drawing for 7 days' Free Examination, shipping charges collect. I will send you $2.00 in 7 days and $2.00 each month until the special price of $14.80 is paid, and you will send me a receipt showing the books are mine. If I decide not to buy I will return the books in 7 days

Name.....

Address.....

References.....

Play while you Pay



ANY violin in our new catalog will be sent you on *trial*. After you have played it a full week you may either return it, or pay the low direct price in small monthly payments. Trial costs you nothing.

200 Years WURLITZER Makers of Violins

Unequaled collection of old masters and fine modern violins.

Write for New Catalog See the wonderful choice you can have of fine violins at all prices. Catalog free, no obligation. Send your name and address today.

The Rudolph Wurlitzer Co., Dept. 1202
S. Wabash Ave., Chicago, Ill.—E. 4th St., Cincinnati, O.

Rider Agents Wanted

Everywhere to ride and exhibit the new Ranger "Motor-bike" completely equipped with electric light and horn, carrier, stand, tool tank, coaster-brake, mud guards and anti-skid tires. Choice of 44 other styles, colors and sizes in the famous "Ranger" line of bicycles.

DELIVERED FREE on approval and 30 DAYS TRIAL. Send for big free catalog and particulars of our *Factory-direct-to-Rider* marvelous offers and terms.

TIRES Lamps, Horns, Wheels, Sundries, and parts for all bicycles—at half usual prices.

SEND NO MONEY but tell us exactly what you need. Do not buy until you get our prices, terms and the big FREE catalog. Write Today.

MEAD CYCLE COMPANY Dept H 109 CHICAGO

due to the fact that the arc sustained by a direct current across a spark gap, after the lightning-discharge current has passed, is more difficult to extinguish than an arc kept up by an alternating current. This principle has been applied in the design of the magnetic blow-out direct-current protector, shown diagrammatically in Fig. 4, where the spark is placed in series with a blow-out coil. When an abnormal voltage breaks down the air gap, current flows to ground through the gap and coil. The tendency is for the direct current in the line to continue to flow across the gap; but the blow-out coil develops a strong magnetic field in which an arc cannot exist. The arc, therefore, is blown out by the field.

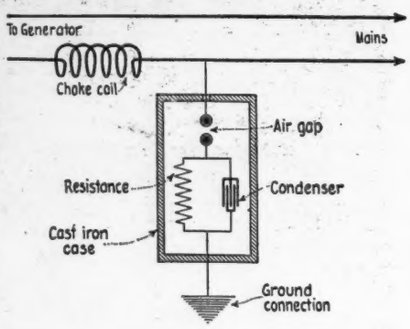


Figure 5

A direct-current arrester, called the condenser type, suitable for medium-voltage circuits

Condenser-Type Arrester

Another form of direct-current arrester is illustrated in Fig. 5. It is called the condenser-type arrester, and is suitable for medium-voltage circuits. It consists simply of a spark gap in series with a resistance, the latter being shunted across by a condenser. The gap prevents the flow of current through the arrester when the voltage is normal. Under abnormal conditions, current is forced across the gap, and the condenser allows discharge to ground. The line current cannot flow, since it cannot pass through the condenser; and, even though the gap may be shorted, the current flow will be negligible, due to the large resistance in parallel with the condenser.

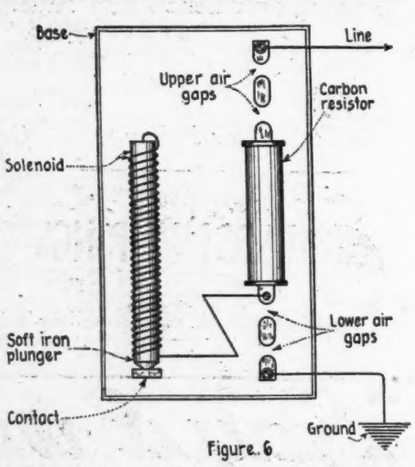


Figure 6

The circuit-breaker arrester consists of four air gaps with a resistance between them

The circuit-breaker arrester, illustrated in Fig. 6, consists essentially of four air gaps with a resistance between them. On the grounded side of the current-limiting resister the two gaps have a solenoid shunted across them. When the solenoid is actuated by a sufficiently intense current, the iron plunger is drawn up, thus opening the circuit. The inductance of the solenoid is so high that practically none of the high-frequency current passes through it.

This abnormal current will pass directly across the spark gaps to ground. If the power current follows the lightning-discharge current, being of low frequency, it will take the path of least resistance, namely, through the solenoid. This will actuate the solenoid plunger and thus extinguish the arc.

For low-voltage alternating circuits the non-arcing metal gap arrester is used, as shown diagrammatically in Fig. 7. In such systems an arc caused by lightning discharge will not be maintained between the metal cylinders by the power current, since it will be extinguished when the power wave passes through its zero value. For relatively high alternating-current voltages, up to 3000 volts, a resistor is inserted in series with the spark gaps so as to limit the power current, which, after an arc has been established by lightning-discharge current, tends to flow to ground.

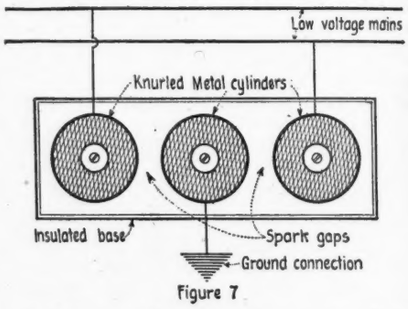


Figure 7

A diagrammatic view of a non-arcing metal gap arrester for low-voltage circuits

Some Other Types

The horn gap arrester, shown in Fig. 8, acts on the principle that an arc established between two horns tends to extinguish itself. Due to the uprising of the column of hot gases, the arc rises on the horns, and finally attains a gap length that it cannot sustain. Arresters of similar form and construction are made for alternating voltages up to 9000 volts. For higher voltages a choke-coil is made up as part of the horn gap. The choke-coil produces a magnetic field, which is described in connection with the magnetic blow-out arrester, and which assists in quenching the arc.

The most effective lightning-arrester for both alternating and direct current of any commercial voltage is,

probably, the electrolytic arrester. Although quite expensive, and requiring a certain amount of care and attention, these disadvantages are of small consequence in cases where costly equipment is to be protected.

The electrolytic protector consists of

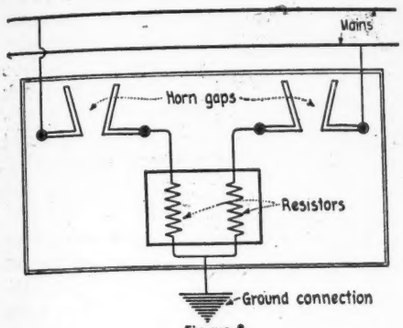
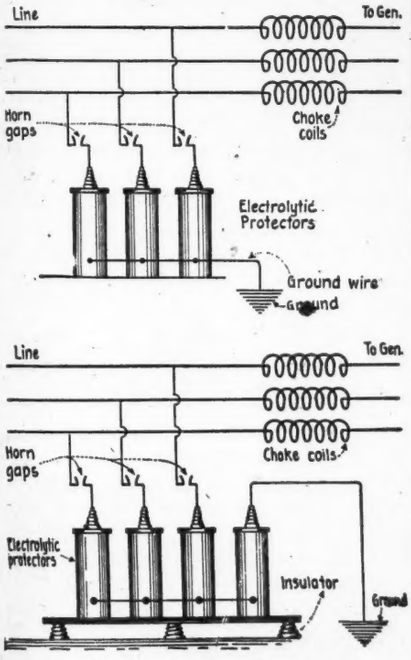


Figure 8

It acts on the principle that an arc between two horns tends to extinguish the arc

a stack of cone-shaped aluminum plates spaced about .3 of an inch apart. An electrolytic solution is poured into the spaces between the plates, and the completed stack is mounted in an iron tank, which is filled with oil. The oil prevents a rapid rise in temperature on discharge, besides keeping the electrolyte from evaporating. The upper plate of the stack is connected through a porcelain bushing to a horn gap, while the lower plate is grounded on the tank, which is, on a grounded neutral system, connected to ground. The illustration below shows a scheme of diagrams for both grounded and ungrounded neutral three-phase electrolytic arresters.

In lightning-arrester installations it



Grounded and ungrounded neutral three-phase electrolytic arresters

is necessary to provide a path to ground with the least possible impedance. In order to accomplish this, large wire and long bends must be used. It is known that lightning-

Dayton Bicycles

THE DAVIS SEWING MACHINE CO. DAVIS MADE DAYTON, OHIO.

The Davis-Made trade-mark shown above, is a *reminder*, and a *pledge*, of QUALITY.

Dayton Bicycles bear this trade-mark. They deserve it. In the war zones of France (responding to Uncle Sam's call) or wherever and whenever there is a desire for exceptional service, the Dayton has justified its high reputation. The Dayton Bicycle is ready to serve you. Write for our catalog B-6. It will be sent gladly.

Cycle Dept., THE DAVIS SEWING MACHINE CO., Dayton, Ohio

The Dayton Military Model — in service in France

Is Record Of This Car

35 MILES PER HOUR

Built by a boy from Junior parts furnished by us. Any boy can build this car. Parts very cheap. Send 26 cents for blue prints and price list of parts showing how to build this speedy little car.

SYPHER MFG. CO. 174 Warren St. TOLEDO, OHIO

SUPERIOR SINCE 1904

Over 100,000 in Use

Mostly sold through recommendation

For Personal Desk or General Office

It checks mental calculations

Buy through your stationer

Write for 10-day Trial Offer

P. E. Gancher, A. A. M. Co. 148 Duane St., New York

Canadian Agency

Golden Gem PORTABLE Adding Machine $12

Multiplies - Subtracts

Agents wanted

TYPEWRITERS

$10 and up. All makes. Save $25 to $50 on rebuilt at the factory by the well-known "Young Process." Sold for low cash—installment or rented. Rental applies on purchase price. Write for full details and guarantee. Free trial.

YOUNG TYPEWRITER CO., Dept. 777, Chicago

FUN

Noiseless Target Practice

Fit your 22 with a Maxim Silencer and get no end of fun this winter practicing in backyard and basement.

MAXIM SILENCER MAKES YOU A BETTER MARKSMAN

It eliminates recoil and all noise of the report, and steadies your aim. Fits any .22 or .22 high power rifle. Book of stories of actual users, free.

FREE BOOK

MAXIM SILENCER CO.

93 Homestead Avenue., Hartford, Conn.

SAVE 25% to 60%

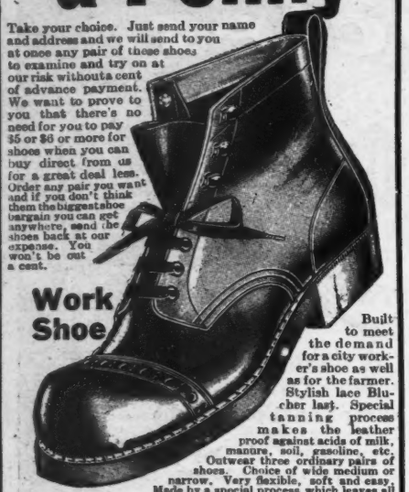
on slightly used GRAFLEX-KODAKS

Cameras and Lenses of every description. Equal to new. Save money. Write now for Free Bargain Book and Catalog listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

CENTRAL CAMERA CO. Dept. 82, 124 S. Wabash Ave., CHICAGO

Dont Send —a Penny—

Take your choice. Just send your name and address and we will send to you at once any pair of these shoes to examine and try on at our risk without a cent of advance payment. We want to prove to you that there's no need for you to pay $5 or $6 or more for shoes when you can buy direct from us for a great deal less. Order any pair you want and if you don't think them the biggest shoe bargain you can get anywhere, send the shoes back at our expense. You won't be out a cent.



Work Shoe

Built to meet the demand for a city worker's shoe as well as for the farmer. Stylish lace Blucher last. Special tanning process makes the leather proof against acids of milk, manure, soil, gasoline, etc. Outwear three ordinary pairs of shoes. Choice of wide medium or narrow. Very flexible, soft and easy. Made by a special process which leaves all the "life" in the leather and gives it wonderful wear-resisting quality. Double leather soles and heels. Dust and waterproof tongue. Heavy chrome leather top. Slip them on and see if they are not the most comfortable shoes you ever wore. Pay **$3.85** on arrival. If, after careful examination, you only don't find them all you expect, send them back and we will return your money. State your size and width. Sizes 6 to 11. Order this shoe by No. X15012.

Stylish Dress Shoe

You must see these shoes to realize what a remarkable value they are. Give wonderful wear. Very stylish and dressy, too. Made of specially selected fine quality gun metal leather on popular swing toe last. Blucher style. Solid oak leather soles. Reinforced shank and cap; military heel. Best expert workmanship. You won't pay $5.00 or $6.00 for shoes when you can have these at our low price. Only a limited quantity at this price. Send now.

We send them at once. When they arrive, pay only **$3.95** If not a stunning bargain, return them and get your money back. Sizes 6 to 11. State your size and width. Order this Shoe by No. X10111.

Work Shoe

Genuine Munson Last

Just the shoe you want for real wear—the genuine Munson last Work Shoe. The wide comfortable last and soft, army toe make this a shoe wonderfully easy on the feet. Specially tanned leather and solid oak leather double soles and heels make this an outdoor and work shoe that will stand all kinds of hard usage, wetting, etc. Comes in tan only. Send no money. Pay only **$4.10** on arrival. Be sure to state your size and width. Order by No. X16012. Sizes 6 to 11.

Examine and see how well made they are. If not satisfactory, return at our expense and get your money back.

Send Today

Remember, you don't need to send a penny with your order. A postal will do. Be sure to state which shoes you want and give size and width. We ship at once. When shoes arrive, pay amount stated for each pair ordered. Examine them carefully. If you think them the biggest shoe bargain you can find anywhere, keep them. Otherwise send them back at our expense and we will promptly return your money. Take your pick and send your order **NOW**—today. Order by correct number as indicated.

Leonard-Morton & Co. Dept. X1871 **Chicago**

discharge currents are confined largely to the outer surface of the conductors, and hence, by using tubing, a large conductor with a large surface is obtained.

If proper ground connections are not provided and maintained, the operation of the arrester may be impaired and trouble may arise. The best method of making a ground connection for protectors is as follows: a large pipe is driven into the earth, and then a smaller pipe is inserted, the space being filled with salt water. A quantity of salt is placed around the pipe, and the ground is thoroughly moistened with water.

In placing pipe grounds care should be taken not to locate them near metal pipes or underground cables in order to avoid trouble from electrolysis.

(*To be continued*)

A Convenient Way to Carry Soldering Paste

A VERY good way to carry soldering paste is in an old lead tube like those in which tooth paste and vaseline preparations are put up. Cut the end off the tube, clean it thoroughly, and fill it with paste, closing the end by crimping it in a vise.—JOHN A. WEAVER.

It Lets Automobiles through, but Halts Cattle

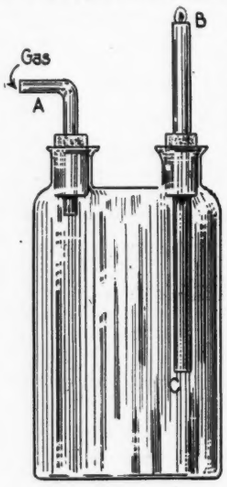
MUCH annoyance and inconvenience is experienced by automobile users in rural districts in opening and closing gates. The United States Forest Service has solved that problem by an automobile cattle guard based on the long established axiom that a cow or horse will not cross an open bridge.

The guard is so constructed as to allow automobiles to pass readily, while stock will not attempt to cross it.

For horse-drawn vehicles there has been provided a turnout with a gate.—JOE B. HOLM.

Experiments to Show How Gas Explodes in a Mine

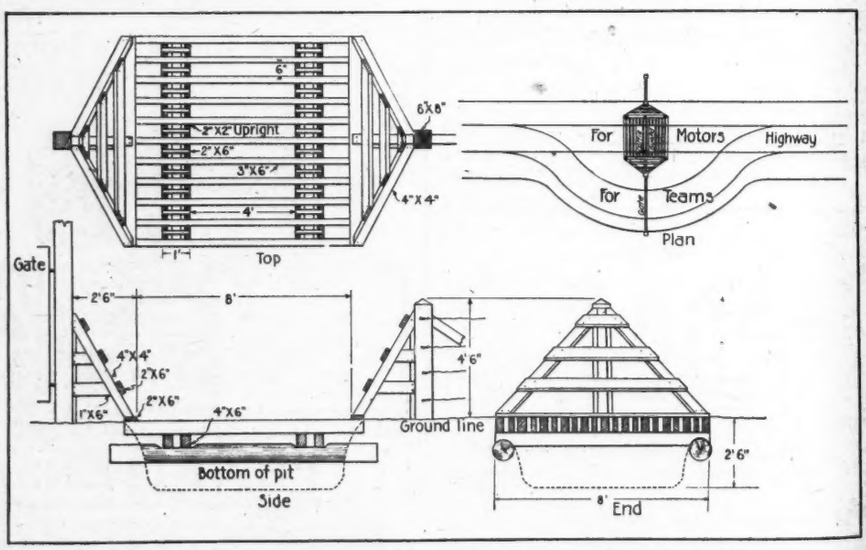
BORROW a large Woulff bottle from the high school laboratory, or procure a gallon can and cut an extra hole in the top. Fit the holes with one-holed stoppers carrying glass tubes as shown in the illustration. The tube *BC* should be of fairly large diameter.



Exploding gas in a Woulff bottle

Connect the tube *A* with a gas-cock by means of rubber tubing, and turn on the gas to drive all the air from the bottle or can. Light the gas at *B* and then withdraw the tube *A* with its stopper, at the same time turning off the gas; but do not stop the flow of gas until the stopper has been partially removed. The gas will continue to burn at *B* with a small flame for some time and then will seem to disappear entirely. The observers will conclude that the demonstration is a failure, when suddenly a very sharp report will occur and the bottle be filled with a sheet of flame.

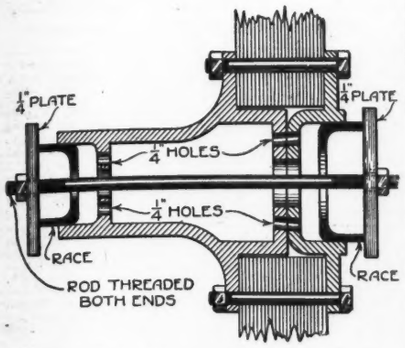
As the gas escapes and burns at *B*, air enters through the open neck until the bottle is full of an explosive mixture of gas and air. The feeble flame at *B* will strike down into the mixture and produce an explosion. This is the cause of the striking back of a hot plate or gas stove when it is first lighted. Apply the match before all the air has been removed from the mixer and the flame strikes back. No danger attends this demonstration, for the gases are not sufficiently condensed.—FLOYD L. DARROW.



An open bridge made like the old-time cattle guard for a railroad track: used on an automobile road to keep stock from crossing, but allowing cars to pass over it. A turnout is made for horse-drawn vehicles

A Tool to Remove and Replace Ball-Bearing Cups

TO remove a ball-bearing race easily, drill four ¼-in. holes in the web back of the race, and use a steel rod



Holes drilled in the web for permitting a punch to be inserted to drive out races

through the holes from the opposite ends of the hub. Tap the rod evenly with a light hammer in all of the holes, and the race will be driven out.

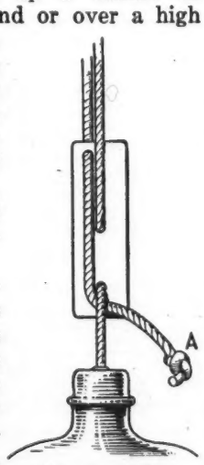
To replace new races, provide a ⅜-in. rod long enough to project 1 in. from each end of the wheel flanges, with standard threads cut on each end. Make two plates to fit on the rod ends as shown, screw up the nuts, and the races are easily forced into place.—P. P. AVERY.

Making Gaskets out of Discarded Inner Tubes

SATISFACTORY gaskets to be placed under conduit covers and other wiring fittings may be cut from a discarded inner tube. If a single thickness of the tube does not suffice, use it two-ply. The salvage value of an inner tube used for this purpose is quite high.—JOHN A. WEAVER.

How to Shorten a Bob String on a Transit

WHEN setting up a transit on sloping ground or over a high stake, it is often necessary to raise the plumb farther than may be done with the ordinary slide. Instead of tying a slip-knot, use the method shown in the illustration.



Slide in string to adjust length

Pull out the knotted end of the string from the hole in the top of the slide at *A*, and slip the loose end under the cord at the bottom of the slide. The weight of the plumb will prevent its slipping, and the hitch can be undone instantly.—E. EARL GLASS.

When the Woods Call You Again

Soon again you can follow your thoughts out into the country, where the trees whisper "Come" to you and roads and byways beckon.

This Spring there will be *three* of you on your week-end outings—you, your pal and your

Harley-Davidson

For another year you will not do without this dependable mount that brings woods and lakes and all outdoors within a short trip's reach.

Red-blooded men and the Harley-Davidson naturally pal together. They appreciate the gameness, the sturdy, "carry on" spirit that made it *the* motorcycle of Uncle Sam and the Allied Armies.

Order yours soon, for the Government still takes part of our output. There may not be enough to go around. See your dealer at once.

Harley-Davidson Motor Co. MILWAUKEE WISCONSIN

BOUND VOLUMES
of Popular Science Monthly

The most interesting and valuable book you can obtain is a bound volume of Popular Science Monthly. It is a history of the World's progress in picture and text. Each volume contains over 2,000 pictures, over 1500 new articles, handsomely printed in a big book of 960 pages.

Volumes are now ready as follows:—Vol. 88 January-June 1916; Vol. 89, July-December 1916; Vol. 91, July-December 1917; Vol. 92, January-June 1918.

Price per bound volume, postpaid, $2.50

Popular Science Monthly, 225 W. 39th St., New York

QUICK-ACTION ADVERTISING

HERE READERS AND ADVERTISERS MEET TO TRANSACT BUSINESS

Rate 20 Cents a Word, payable in advance. 10% Discount for Six Insertions. March issue closes January 20th

AUTOMOBILES AND ACCESSORIES

HYDRONIZER—Insures clean plugs, consumes carbon, saves gasoline, saves repairs and is easy to sell. Money back guarantee. Fits all cars. Fords do 34 miles to gallon. Thousands in use. Have attractive proposition for energetic and responsible agents, also unique advertising. Agents' price permits wholesaling and retailing. Write for free literature. Friestedt Manufacturing Company, 2933 W. Lake St., Chicago, Illinois.

CONVERT your bicycle into a motor-cycle at small cost by using Shaw Motor Attachment. Catalog free. Shaw Mfg. Co., Dept. 180, Galesburg, Kansas.

PATENTS for automobiles are in great demand. We have special Automobile Department in charge of experts who are in touch with demands of trade. Write for free illustrated Guide Book, "How to Obtain a Patent." Victor J. Evans & Co., 172 Ninth, Washington, District of Columbia.

BATTERY Charging pays big profits. City currents or gas engine operates. Easy terms. Hoberts, Troy, Ohio.

INSYDE Tyres, inner armour for Automobile Tires, prevent punctures and double mileage of any tire. Liberal profits. Details free. American Accessories Co., Dept. 97-A, Cincinnati, Ohio.

TIRES—Double Tread Guarantee for good service. Absolutely Puncture-Proof. Big—Strong—Extra heavy 30x3 tire, $5.50; 30x3½, $7.00; 33x4, $10.00; 34x4, $10.75; 36x4½, $13.00; 37x5, $14.00. Big saving on other sizes and tubes also. Trade in your old tires. Discount to dealers. 10% deposit required on C. O. D. orders. Send for list now! State size and bead of tire. Max Liben & Co., 206P West 48th Street, New York.

TIRES At Wholesale—Send For Prices on guaranteed tires and tubes. Lowest prices on earth. Overton Tire Co., Box P, Oelwein, Iowa.

"GAS-SOL" gives you 15 to 40% more mileage and eliminates carbon. Money back Guarantee. 100 tablets treat one hundred gallons gasoline. Price One Dollar. Live agents wanted. Gas-Sol, Dept. B, Wakefield, Mass.

MORE Power, less fuel, no carbon. No mystery, plain facts, results guaranteed. Write for booklet. No-Leak-O Piston Ring Company, Baltimore, Maryland.

VULCANIZING auto-tires is a growing and profitable business. Easy to learn. Instruction book, $1. Plants $50 to $300. Details free. Equipment Co., 302 8th Street, Cincinnati, Ohio.

TIRES ¼ less. Buy direct at manufacturer's price. Guaranteed 6000 miles. Shipped prepaid on approval. Motorist Agents wanted. Write today. Give size of tires. Liberty Tube & Tire Co., 842 Grand Avenue, Kansas City, Missouri.

AUTO Motors and supplies. Buick—Hupp—Franklin—Michigan—Everett—Both water and air cooled Motors $30.00 each and up. Bosch Magnetos—$10.00 each and up—Presto Tanks $5.00—Coils $3.00—Carburetors $5.00—Electric Head Lamps $4.40—Spot Lights $3.40—Motor Horns $2.85. Air Compressors, etc. Write for Bargain List second hand auto accessories. Johnston, West End, Pittsburgh, Pennsylvania.

MR. ADVERTISER: If you knew as much about the pulling-power of Popular Science Monthly as the advertisers represented in its columns, your advertisement would be in this space. We will be glad to give you some interesting information about this department. May we? D. W. Coutlee, 225 West 39th Street, New York City.

VULCANIZE on Anderson's Famous Vulcanizer. See our advertisement, page 125.

FORD ACCESSORIES

FORDS Start Easy in Cold Weather with our new 1919 carburetors. 34 miles per gallon. Use cheapest gasoline or half kerosene. Increased power. Styles for any motor. Very slow on high. Attach it yourself. Big profits to agents. Money back guarantee. 30 days' trial. Air-Friction Carburetor Co., 500 Madison, Dayton, Ohio.

DEMOUNTABLE Outfits complete, $12.50. Demountable sets, $5.50. Good agents' proposition. Kable, West End, Pittsburgh.

SUNLIGHT for Fords! Bright light all speeds, with dimmer, $2.50 guaranteed. 100% Profit for agents. Sunlight System Company, 1508 Lytton Building, Chicago, Illinois.

ELECTRICAL

MAKE Dry Batteries. Simple, practical instructions, with blue print, 25 cents. Dirigo Sales Company, Bath, Maine.

INVENTORS. Send sketch and description of your invention for advice regarding patent protection. Twenty years experience. Our hand-book on patents is sent free on request. All communications strictly confidential. Write us today. Talbert & Talbert, Patent Lawyers, 4675 Talbert Bldg. Washington, D. C.

ELECTRICAL supplies including generators, motors. Free catalog. Hyre Electric Company, 629 ZB South Dearborn Street, Chicago.

PROSTATOLOGY is our free booklet on prostate gland disorders, see our add under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

WELDING

WELDING Plants, $25,00 to $300.00. Designed for all purposes. Small cash payment, balance three to six months. Every mechanic or shop should have one. Bermo Welding Co., Omaha, U. S. A.

TRADE SCHOOLS

HILES' Watchmaking and Engraving School, the largest and best equipped school in the West. 717 Market Street, San Francisco, California.

AVIATION

PATENTS wanted in Aeronautics. U. S. Government spending millions in this class for Army and Navy. Our Aeronautical Department will give full information on this subject. Write for our free book, "How to Obtain A Patent." Victor J. Evans & Co., 179 Ninth, Washington, District of Columbia.

MEN: Learn aviation, motor mechanics and aeroplane building. Earn $1.00 to $2.00 an hour when skilled. Wonderful future. Big government plans. Write. Moler Aviation School, 105 South Wells, Chicago, Illinois.

BUILD the Marinette Monoplane; use motorcycle engine. Stamp for particulars. M. Meyler, 218 East Main Street, Kalamazoo, Michigan.

CHICAGO Aero Works—Chicago—Great construction textbook. Headquarters airplane blueprints.

BUILD that new airplane now for the coming flying season. Write for catalogue "L" and bargain motor. Send 12c in stamps to America's oldest aeronautical supply house. Heath Airplane Company, Chicago.

MODELS AND MODEL SUPPLIES

TO avoid mistakes, inventors should have correct models made before filing for patent. Write Adam Fisher Mfg. Co., 183E, St. Louis, Missouri.

Popular Science Monthly,
225 West 39th Street,
New York City, N. Y.

Gentlemen:

The fact that we are increasing our space in the classified section proves that Popular Science Monthly is paying us, but we will add, results from your magazine are wonderful.

The returns have been beyond our expectations, although we had often been told that your classified columns were successful for others.

Not only have we received hundreds of replies to our advertisement, but we have done hundreds of dollars worth of business. Need one say more?

Very truly yours,
WAGNER COMPANY.

DUPLICATING DEVICES

"MODERN" Duplicator—a Business Getter. $1. up. 50 to 75 copies from pen, pencil, typewriter; no glue or gelatine. 35,000 firms use it. 30 days' Trial. You need one. Booklet Free. J. V. Durkin & Reeves Company, Pittsburgh, Pa.

MR. ADVERTISER: If you knew as much about the pulling-power of Popular Science Monthly as the advertisers represented in its columns, your advertisement would be in this space. We will be glad to give you some interesting information about this department. May we? D. W. Coutlee, 225 West 39th Street, New York City.

MISCELLANEOUS

ELECTRICAL Tattooing Machine, $3, $5, and $7. Catalogue for stamp. J. H. Temke, 517 Central Pam., Cincinnati, Ohio.

STAGE career offered you. Experience unnecessary. Send stamp for instructive booklet "All About Vaudeville." LaDelle, Station 153, Jackson, Michigan.

MANUFACTURING

SPECIALTIES of all kinds manufactured for market. Write Adam Fisher Mfg. Co., 183F, St. Louis, Missouri.

SOAP Saver! New invention! Patent applied for. For sale or royalty. Manufacturers write at once! N. I. Ward, 7 Myrtle Street, Bellows Falls, Vermont.

HAVE you an idea to develop, a machine to perfect, a product to be manufactured? Do you need special machinery to reduce the cost of your product or a first-class model built, tools, dies or any kind of machine work? If so, send us a card for our illustrated booklet for manufacturers and inventors. Central Machine Works, 1911 North 12th Street St. Louis, Missouri.

MOTORCYCLES, BICYCLES, SUPPLIES

MOTORCYCLES all makes, $25.00 up. New bicycles at big reduction. Second hand, $8.00 up. Motors, motor attachments. Cycle motors. Smith motor wheels, etc., $20.00 up. New parts to fit all makes carried in stock. Second hand parts good as new 50% discount. Expert repairing, on magnetos, generators, transmissions. Motors overhauled $10.00 up. Henderson motors our specialty. Write for big bargain bulletin. American Motor Cycle Company, Dept. 3, Chicago.

CONVERT your bicycle into a motorcycle at small cost by using Shaw Motor Attachment. Catalog free. Shaw Mfg. Co., Dept. 68, Galesburg, Kansas.

BARGAINS in used Harley, Excelsior, Henderson and Indian Motorcycles; condition guaranteed, $40.00 to $250.00. Write for terms and new bulletin. Charles A. Merkle, 162 North Clinton Avenue, Rochester, New York.

WANT to sell that motorcycle of yours? I have a method that has sold many. Write today for details; a postcard will do. D. W. Coutlee, 225 West 39th Street, New York City.

TRANSFER name plates. Send for price list. Globe Decalcomanie Mfgrs., Jersey City, New Jersey.

FORMULAS & TRADE SECRETS

WILL furnish a typewritten, guaranteed Formula or Trade Secret for any purpose for only 25c. State exact requirements enclosing coin. Raymond, 1354S Central Cleveland, Ohio.

50 FORMULAS 10c. Catalog 2c. Bestovall Laboratories, 3311-PS., Bellepiaine, Chicago.

PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

GRANDFATHER'S CLOCKS

GRANDFATHER'S Clock Works $5.00. Build your own cases from our free instructions. Everybody wants a hall clock. You can make good profit building artistic clocks for your friends. We replace worn-out works in old clocks with works having chimes at money saving prices. Write for folder describing the most beautiful hall clock ever sold at $25.00. Clock Co., Nicetown, Pennsylvania.

SHOP EQUIPMENT AND MATERIALS

YOU Make UmakeM Lathes. You make UmakeM Work Benches. You make UmakeM Novelties. For Material and outfits address UmakeM, Twenty UmakeM Building, Fifth Avenue, New York.

MOTORS, ENGINES, MACHINERY

BLUE Prints, Castings, Small Engines, Steam, Gas, Circulars, Stamp. Universal Gas Motor Company, Monadnock Block, Chicago.

SMALL Motors and Generators: 1000 New Motors and Generators from bankruptcy stock—¼ H. A.C. $18.50 each—½ H.P. $30.00. Battery Charging Sets—Robbins & Myers New outfits all sizes, $30.00 each and up. Charging Lighting & Moving Picture Arc Generators $10.00 each and up. Motors for all phases of current. Immediate Delivery. Less than ½ regular prices. Write for late Bulletin. Johnston, West End, Pittsburgh, Pennsylvania.

ELECTRIC motors, supplies, generators. Reliable makes. Illustrated list free. Hyre Electric Company, 629 FM South Dearborn Street, Chicago.

CHEMICAL SERVICE

CHEMICAL analyses; formulas; manufacturing problems solved and developed; patents and trade-marks. National Laboratories, 407 Ouray Building, Washington, District of Columbia.

TELEGRAPHY

TELEGRAPHY, wire and wireless, and railway accounting taught thoroughly. Unprecedented demand for both sexes. Big salaries. Oldest and largest school—established 45 years. Catalog free. Dodges Institute, Second Street, Valparaiso, Indiana.

BOATS AND LAUNCHES

DARROW'S Steel Boats. Finished parts for patterns. Catalogue, 78 models. F. H. Darrow, 604 Erie Street. Albion, Michigan.

LABORATORY EQUIPMENT

CHEMICALS, latest prices. Complete experimental, weighing, titration, and blow-pipe laboratories. Outfits, apparatus and supplies. Consult us before buying. Clarence Appel, Mathews Avenue, Knoxville, Pittsburgh, Pennsylvania.

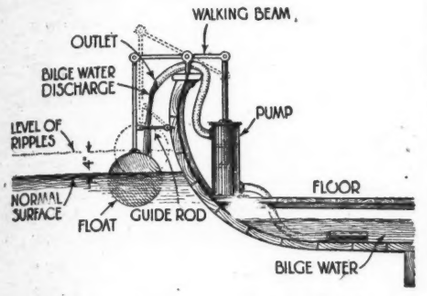
ADDING MACHINES

WONDERFUL Adding Machine seven columns capacity, only one dollar. Adds and multiplies as fast as the fingers will move. Thousands being sold through demonstration. L. J. Leishman Company Dep't L., Ogden, Utah.

INVESTIGATE Marvelous Calculator Adding Machines. Subtracts, multiplies, divides automatically. Work equals $300 machine. Price $10. Five year guarantee. Illustrated catalog and trial offer free. Calculator Corporation, Grand Rapids, Michigan.

Making the Waves Operate a Motor-Boat Bilge-Pump

BY utilizing the power of the ripples on the water surface, a motor-boat owner provided himself with a bilge-pump that pumps out his boat automatically. The pump can be



The action of the wave works the float that propels the pump piston

used wherever the waves attain a height of 4 in. or more.

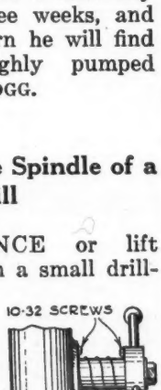
The undulations on the surface of the water cause a large wooden float to rise and fall. This, in turn, operates a walking beam on the gunwale of the boat, as shown in the sketch, and serves to move the jack-rod of an ordinary bilge-pump. Thus the pump is kept in operation even when the boat is left unattended. If the bilge-well is pumped dry it goes on pumping just the same, and any water that seeps in is immediately sucked up and sent through the hose and over the gunwale.

The walking-beam over the gunwale is screwed into a quarter-turn socket, while the guide-rod that holds the float away from the side of the boat is attached by means of snap-eyes. This method of installation enables the boatman instantly to detach the mechanism and lift it into the boat when getting under way.

With this arrangement a boat may be left as long as three weeks, and upon the owner's return he will find the bilge-well thoroughly pumped out.—JOHN EDWIN HOGG.

A Spring Lift for the Spindle of a Small Drill

A COUNTERBALANCE or lift for the spindle on a small drill-press would be very useful for many operations. The illustration shows how the owner of one of these small machines attached a spring for the lift. It consists of a coil-spring inserted in the housing, and one on the collar of the hand-feed handle. When the pressure is released on the hand lever the spring will lift it out of the work.—W. F. QUACKENBUSH.



The coil-spring on handle for a lift

PRINTING, ENGRAVING, MULTIGRAPHING

100 perfumed cards, $1.50. Kamholtz, 117A West 33rd, New York.

GOOD Printing at low prices; 1,000 good letterheads, envelopes, cards, billheads, labels, circulars, $2.50; samples free; catalogues, booklets and circulars our specialty. Ernest L. Fantus Co. 523 S. Dearborn St., Chicago, Ill.

100 CARDS, Business, Professional or Social, also imitation leather card case, for 60 cents. M. F. Devaney, Printing, Engraving, Rubber Stamps, 31 Middle Street, Geneva, New York.

125 Letterheads, envelopes, billheads, tags, or cards, 75c postpaid. Printer-Laborde, Mansura, Louisiana.

100 Bond Noteheads, 4 lines, and 100 envelopes, prepaid $1.00. Southwestern, 1413-B Berendo, Los Angeles.

ACTUAL Typewritten Letters, heading black, body purple 100, $1.15; 500, $2.00; 1000, $3.25; 5000, $12.00. Artus Letter Shop, 409 Chestnut Street, Milwaukee, Wisconsin.

NEW large catalog of attractive Gummed Labels and advertising stickers free. Royal Label Company, 414 Cherry, Philadelphia.

MR. ADVERTISER: If you knew as much about the pulling-power of Popular Science Monthly as the advertisers represented in its columns, your advertisement would be in this space. We will be glad to give you some interesting information about this department. May we? D. W. Coutlee, 225 West 39th Street, New York City.

AUTHORS—MANUSCRIPTS

WRITERS: Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Missouri.

WRITE for newspapers and magazines. Big Pay. Experience unnecessary; details free. Press Reporting Syndicate, 400, St. Louis.

MANUSCRIPTS typed, lowest rates. Editorial criticism and revision. Our booklet aids ambitious writers. Mailed free. Story-Craft, Washington, D. C.

EDUCATIONAL AND INSTRUCTION

WANTED—New Ideas. Write for list of Patent Buyers and Inventions Wanted. $1,000,000 in prizes offered for inventions. Our four Books sent free upon request. Victor J. Evans & Co., 178 Ninth, Washington, D.C.

STUDY bacteriology, public health, and sanitation. Exceptional opportunities. Remunerative positions. Interesting studies. Day and evening courses. Part work may be done at home. Write for information. Chicago Hospital College of Medicine, 3832-N, Rhodes Avenue, Chicago.

PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

MOTION PICTURES

FREE TO Writers—a wonderful little book of money-making hints, suggestions, ideas; the A B C of successful story and play-writing. Absolutely Free. Just address: Writer's Service, Dept. 6, Auburn, N. Y.

WRITE Photoplays: $50 each. Experience unnecessary; details free to beginners. Producers' League. 194, St. Louis.

ELECTRIC Arc Generator halves expense. Your engine operates. Easy terms. Hoberts, Troy, Ohio.

PHOTOPLAYS Wanted. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175, F 10, Chicago.

TYPEWRITERS AND SUPPLIES

LARGEST stock of Typewriters in America. Underwoods, way under manufacturer's prices. Rented anywhere, applying rent on purchase price; free trial. Installment payment desired. Write for catalogue 11. Typewriter Emporium (Estab. 1892). 34-36 West Lake Street, Chicago, Illinois.

NEW, rebuilt and slightly used Typewriters $8 up. Portable Machines $10 up. Write for our Catalog 25Q. Beran Typewriter Co., 58 W. Washington St. Chicago.

PHONOGRAPHS AND SUPPLIES

BUILD your Phonograph. "Perfection" high quality spring and electric Motors, Tone Arms, Reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Indiana.

CAMERAS, PHOTOGRAPHY, SUPPLIES

MAIL us 15c with any size Film for development and 6 velvet prints. Or send 6 negatives any size and 15c for 6 prints. 8 x 10 mounted enlargements 35c. Prompt, perfect service. Roanoke Photo Finishing Co., 212 Bell Avenue, Roanoke, Virginia.

FILMS developed free! Prints 2½c, 3c. Postcards 3c. 8x10 enlargements from negative, 30c; 4, $1.00. Prepaid. Regular prices, 24-hour-service guaranteed. No stamps. Get list. Emil Sprauer, Hamilton, Ohio.

CAMERA bargain list free! Durso, 25 Mulberry, New York City.

RUBBER STAMPS

RUBBER stamps—stamp for catalog. Box 458, Middletown, New York.

LITERARY

SPEECHES, essays, distinctive advertising letters, pamphlets, and special articles prepared for all occasions. 500 words $1.50. Gertrude Sanborn, 778 Farwell Avenue, Milwaukee, Wisconsin.

DIAMONDS, WATCHES, JEWELRY

FREE—Scientific Gem. Rivals diamond. Clear white, brilliant, flashing, deceives experts. Free examination. Write for booklet today. Harold Lachman Co., Dep't. 9202, 12 North Michigan Avenue, Chicago.

FOR MEN AND WOMEN

WHAT Do You Want to Know?—Information vital to the student, the experimenter, the business man, or any inquirer given by experts. Educational, Scientific, Legal, and Business questions answered. Ask us the points you cannot find out anywhere else—we usually know. No charge if unsuccessful, small fee of $1 if we set you right. Send your questions direct from this ad., or write for our complete proposition, free. The Kent System, Department A, Cambridge, Mass.

INDIAN Baskets—Wholesale and retail, Catalogue. Gilham, Highland Springs, California.

"SEXUAL Philosophy," 12c. Clear, specific, authoritative, complete, best satisfies. Fred B. Kaessmann, Lawrence, Mass.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

CORNS—Get them out with the Root. Bailey's Corn Solvent will do it. 30c stamps. Mikol Company, 701 Fillmore, Buffalo, New York.

CATCH Fish all winter! Information for stamp. George Julian, Albany Building, Boston.

LEARN why men are Uninteresting and How to become Interesting. Details free. Alice Barrett, 116 North Main, Hobar, Oklahoma.

DO you wish to know? How to attain success? How to gain a winning personality? How to improve your memory 100 per cent. in 30 days? How to become what you wish to be? Our course in Personal Efficiency has shown thousands how to get more out of life and it can show you. Write today for introductory lesson free. Thomson-Heywood Co., Dept. 700, Chronicle Building, San Francisco, California.

PROSTATE gland sufferers should have our free booklet showing a new drugless way to rapidly eradicate these disorders. No massage, exercise or diet. In use by physicians, osteopaths, physical culturists, etc. Easily used by any one privately. Correspondence absolutely confidential. The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

MUSIC AND SHEET MUSIC

SONG Writers: Submit your song-poems now for free examination and advice. Valuable booklet explaining our original methods of revising, composing, copyrighting and facilitating free publication or outright sale of songs, Sent Free on postal request. Learn the truth from a reliable successful concern. Satisfaction guaranteed. Knickerbocker Studios, 168 Gaiety Building, New York.

WRITE the Words for a Song. We write music, guarantee publisher's acceptance. Submit poems on patriotism love or any subject, Chester Music Co., 538 South Dearborn Street, Suite 111, Chicago.

WRITE a Song—on any subject. I compose music and guarantee publication. Send words today. Thomas Merlin, 238 Reaper Block, Chicago.

WRITE the words for a song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 121C Fitzgerald Building, New York.

MR. Song Writer: Before investigating any other proposition, investigate ours first. Submit poem today; examined free. The Kolker Harmony Studio, 4106 Lancaster Avenue, Philadelphia, Pennsylvania.

FOR SALE AND EXCHANGE

PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

REAL ESTATE—FARM LANDS

IS this your idea of Florida? A little piece of land near the water, a boat, a garden, some strawberry plants, and perhaps a few chickens; a vine covered cottage, pleasant neighbors; fish and oysters in abundance, plenty of quail and game—a simple, natural, wholesome life in the open the year round—Home, Health and Contentment. All this is within your reach at modest outlay in this beautiful land of sunshine and roses. We are on the Gulf and a navigable river, also on the Dixie Highway, and we are only two hours by auto jitney from Tampa and St. Petersburg. Here we have the freedom, comfort and economy of country life, yet are within easy access of the big cities and resort centers. Our community is new, but is one of the fastest growing in the state. Prices have not gone sky-high, and living expenses are moderate. 100 Northern families already here. They like it—perhaps you will. May we send complete information? Board of Trade, Box 105, New Port Richey, Florida.

MONEY-MAKING farms—17 states—$10 to $100 acre. Stock, tools, crops often included to settle quickly. Write for big illustrated catalogue. Dept. 12, E. A. Strout Farm Agency, New York.

FREE book of Florida facts. If interested in Florida, before visiting or settling in this wonderful state of fragrant flowers and sunshine, write Lake County Land Owners' Association, No. 205 Lloyd Street, Fruitland Park, Florida, for free book of actual photographs and real conservative facts concerning this State. There is poor, good, better and best land in Florida. This book will teach you what is best and why. The members of the association are not land agents; they simply wish to tell actual facts so those really interested in the State. They have no time to waste on curiosity seekers, children or people who expect to grow rich without effort, but to those of character, energy, some capital, with a desire to learn more of the opportunities in this most prosperous State we would be glad to give fullest information.

CALIFORNIA little farms, near Los Angeles, for sale. Easy payments. Write E. R. Waite, Shawnee, Oklahoma.

THE Real Estate Educator—A Book for hustling real estate boosters, promoters, town builders and every man who owns, sells, rents or leases real estate. Covers fully Workmen's Compensation Act, Income Tax Law, Employer's Liability Act, Statute of Frauds, How to Sell Real Estate, How to Become a Notary Public or Commissioner of Deeds, "Pointers," "Don'ts" and other information. 256 Pages. Cloth, Price, $1.50. Book Department, Popular Science Monthly, 225 West 39th Street, New York.

STAMMERING

STAMMERING cured—quickly, permanently, and privately. Write me personally for Free Copy of new book, "How to Stop Stammering." S. E. Robbins, Prin. Boston Stammerers Institute, 246 Huntington Avenue, Boston, Massachusetts.

ADVERTISING

YOUR advertisement in the classified columns of the Electrical Experimenter, Science and Invention, will reach the very class of men you seek. Circulation 100,000 net. Rate 7c word. The Electrical Experimenter brings positive results. For proof, address Classified Department, 233 Fulton Street, New York.

SPECIAL! Inch display advertisement 100 magazines, thrice, $8.00. Coast to Coast Syndicate, Atlantic City.

GAMES AND ENTERTAINMENT

NEW Patriotic Plays, Recitations, Entertainments for war-time Benefits. Vaudeville Sketches, Monologues, Drills, Tableaux, Make-Up Goods. Large Catalog Free, T. S. Denison & Co., Dept. 26, Chicago.

TRICKS and Greenbacks. Big magic catalog 5c, Twenty greenbacks—10c. Gilmagico, 1115 So. Irving, Chicago.

1,000 stage tricks with 500 illustrations. Catalogue 10c. small catalogue FREE. Hornmann Magic Co., Sta. 17, 470 Eighth Avenue, New York.

TRICKS, Puzzles, Jokes, Toys, Games, Novelties, Dolls and Cane Racks, Plays, Wigs, Stage Supplies, Escapes and Illusions. Large 1918 Catalog Free. Oaks Magical Company, Dept. 535, Oshkosh, Wisconsin.

PORTEMANTEAU Theatres constructed. Scenery for hire. Catalog. Amelia Grain, Philadelphia.

LEADING Magical Magazine—The Eagle Magician. Sample, 10c; Three Months' Trial, 25c; Year, $1.00. Latest Magical Catalogues free. P. S. Pentz, Minneapolis, Minnesota.

FOR BOYS

AVIATION Speedster from bicycle parts; what you need to buy costs very little. New high speed invention. Complete plans, 25c. Aerocar, Racine, Wisconsin.

PICTURES AND POSTCARDS

JOIN Live Postcard Club. Membership Papers 10c. Harvey Teeple, Decatur, Indiana.

DO you like pictures? If so, your name please: O. W. Miller, C105 Chambers Street, New York.

BEAUTIFUL, attractive pictures for dens, clubrooms, etc. Send dime for generous sample, descriptions, lists, prices, etc. If you want pictures worth having, these are sure to please. Jorst, Box 253, Saginaw, Michigan.

FIVE prettiest women cards, hand colored, 25c. Durso, Dept. 42, 25 Mulberry Street, New York City.

PATENTS FOR SALE

PATENT on Ship Protector. A meritorious device. Will protect ship from mishaps and in war. Write: Walter Piasecky, 48 Washington Street, Cambridge, Massachusetts.

THE war is over—now for the twentieth century window and porch screen. State rights or royalty. Patented. Nelson, 484 Prospect Place, Brooklyn.

JUST invented; millions will be used in the United States alone. Wesley Stackpole, Monroe, Washington.

AUTOMATIC Hat Fasteners; would do away with open hatpins. Something new in Millinery. Price $15,000, Mrs Lena Zierold, 1108 Maple Avenue, Wilkinsburg, Pennsylvania.

WE have a few practical money-making inventions for sale or trade. Adam Fisher Mfg. Co., 183B, St. Louis, Missouri.

FOR INVENTORS

600 Mechanical Movements, also illustrations and explanations of 50 perpetual motions. My book, Inventors' Universal Educator, 4th edition, tells how to procure and sell a patent for your new invention. Government and other costs. Covers the matter from A to Z. 140 pages elegantly bound. Contains noted Court decisions on Patent cases. Mechanical Movements greatly assist inventors—suggest new ideas that might prove of great aid in perfecting inventions. Tells how to select an attorney. Has valuable information regarding Patent Sharks, Selling agents and brokers. Price $1.00. Postage free. Fred G. Dieterich, 681 Ouray Building, Washington, D. C.

THE Electrical Experimenter Classified Columns bring positive results. Circulation 100,000—rate 7c word. For information address Classified Department, 233 Fulton Street, New York.

PATENTS. Write for free illustrated guide book. Send sketch or model and description for free opinion of its patentable nature. Highest references. Prompt attention. Reasonable terms. Victor J. Evans & Co., 156 Ninth, Washington, D. C.

INVENTORS—We specialize in manufacturing new, patented articles, make models—dies—and do experimental work. Modern Tool & Manufacturing Co., Dept. E., Opera Place, Cincinnati, Ohio.

HAVE you a practical invention to sell outright or place on royalty? Send details to Adam Fisher Mfg. Co., 183 A St. Louis, Missouri.

PATENTS promptly procured. Send drawings for actual search of U. S. patents. Personal service. Moderate fees. Write for free patent book. George P. Kimmel, patent lawyer, 82N Oriental Binding, Washington, D. C.

INVENTORS join National Institute of Inventors, World Building, New York City; membership society 1900 strong; will help you protect, develop, finance and market your invention. Absolutely no charge. Write for booklet.

INVENTORS. Send sketch and description of your invention for advice regarding patent protection. Twenty years experience. Our hand-book on patents is sent free on request. All communications strictly confidential. Write us today. Talbert & Talbert, Patent Lawyers, 4691 Talbert Bldg. Washington, D. C.

MR. ADVERTISER: If you knew as much about the pulling-power of Popular Science Monthly as the advertisers represented in its columns, your advertisement would be in this space. We will be glad to give you some interesting information about this department. May we? D. W. Coutlee, 225 West 39th Street, New York City.

PATENTS. My fee payable in installments. Full particulars return mail. John Patten Duffie, patent attorney, Washington, District of Columbia.

INVENTORS! We have a proposition that will probably interest you. Inquiries invited. The Wakefield Engineering Company, 922A F St., N. W., Washington, D. C.

INVENTORS: Write us immediately if you have an invention or patent to sell. Western Security Co., 200, Hannibal, Missouri.

PATENTS. Fees payable monthly instalments. Free books and advice. Frank Fuller, Washington, D. C.

PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

READERS of Popular Science Monthly—here's your chance: We have on hand a limited number of bound volumes: No. 88—January to June, 1916; No. 89—July to December, 1916; No. 91—July to December, 1917. These copies are beautifully bound in heavy gray covers with dark green backings, containing the words "Popular Science Monthly," the volume number and months included. Each volume comprises 960 pages, 1306 articles and 2,082 pictures. Just the thing for your library. A ten page index enables you to find in a moment any article or picture desired. Contain no advertising whatever. At the present cost of printed matter, these volumes should retail at $5.00. You can secure them now for $2 50 each postpaid. Book Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York City.

PATENT ATTORNEYS

PATENTS: Our practice before the Patent Office extends over seventy years. It pays to employ an attorney of reputation as a poor patent is a bad investment. Ability and Reliability are our special partners. We are also the publishers of the Scientific American and all patents secured by us are described without cost in the Scientific American. Your invention is thus brought to the attention of thousands of intelligent readers especially interested in such matters. To procure like publicity in any other manner would cost you many times the patent fees. Our Hand Book on Patents sent free on application. Munn & Co., Patent Attorneys, 624 Woolworth Building, New York, and 625 F St., Washington, D. C.

PATENTS, Trade Marks, Copyrights. Prompt, personal, reliable service. Over 30 years' active practice. Write for terms. Book free. Address E. G. Siggers, Box 1, N. U. Building, Washington, D. C.

PATENTS. Write for free illustrated guide book. How to Obtain A Patent. Send sketch or model and description for free opinion of its patentable nature. Highest references. Prompt attention. Reasonable terms. Victor J. Evans & Co., 155 Ninth, Washington, D. C.

DON'T lose your rights. Send for blank form, "Evidence of Conception" to be signed and witnessed. Establish your rights before disclosing your invention to anyone. Form and information concerning patents, free. Lancaster & Allwine, 232 Ouray Building, Washington, D. C

YOUR idea wanted. Patent your invention. I'll help you market it. Send for 4 free books, list of patent buyers, hundreds of ideas wanted, etc. Advice free. Patents advertised free. Richard B. Owen, Patent Lawyer, 44 Owen Bldg., Washington, D. C., or 2276Z Woolworth Bldg., New York.

PATENTS—Herbert Jenner, patent Attorney and mechanical expert, 622 F St., Washington, D. C. I report free of charge if a patent can be had and its exact cost. Send for circular.

WE promote patents obtained through us. Adam Fisher Mfg. Co., 183C, St. Louis, Missouri.

M. E. MILLER, Ouray Building, Washington, D. C.—Patent Attorney, Mechanical and Electrical Expert. Best quality of work and results. Moderate charges. Advice free.

PROTECT your inventions. I help you market them. Expert advice and The Truth about Patents free. J. Reaney Kelly, 912A Woodward Building, Washington, D. C.

TO Market Your Invention, you must get in touch with the proper person. Let me show you how to do it. D. W. Coutlee, 225 West 39th Street, New York City.

PATENTS, Trade-Marks, and Copyrights Secured. Book and Blank Forms sent on request. Send sketch. A. M. Buck & Company, 534-7th, Second National Bank Building, Washington, D. C.

LACEY Patent-Sense. "The Book the Inventor Keeps." See page 113.

PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

PATENTS promptly procured. Send drawings for actual search of U. S. patents. Personal service. Moderate fees. Write for free patent book. George P. Kimmel, patent lawyer, 82N Oriental Building, Washington, D. C.

FORTUNES from patents are made only from a good invention strongly protected. Send sketch or model and $5 for thorough search and honest opinion of patentability. I give personal, conscientious and expert service. Lester, L. Sargent, patent attorney, 524 Tenth Street, Washington, District of Columbia.

INVENTIONS patented; trade-marks registered; labels prints and publications copyrighted; reasonable fees; correspondence solicited; detailed information free; booklets. Jaynes & Jaynes, 701 Kellogg, Washington, D. C.

PATENTS procured; reliable service. "The Last Word on Patents" FREE. Sanders, 2 Webster Building, Chicago, Illinois.

PATENTS! Foremost word free. Write now. Metzger, Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C.

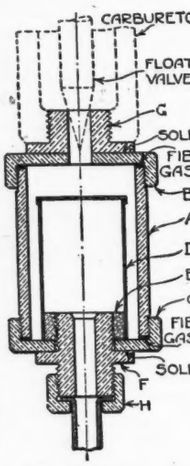
"PATENTS and Patent Possibilities" is a valuable booklet which tells all about patents, and is full of interesting information for inventors. Frequent causes of failure are explained. Sent free together with form "Proof of Conception" to be signed and witnessed for your protection before filing application. H. S. Hill, 929 McLachlen Building, Washington, D. C.

INVENTORS. Send sketch and description of your invention for advice regarding patent protection. Twenty years experience. Our hand-book on patents is sent free on request. All communications strictly confidential. Write us today. Talbert & Talbert, Patent Lawyers, 4624 Talbert Bldg., Washington, D. C.

"TWENTIETH CENTURY BOOK OF RECIPES, FORMULAS AND PROCESSES"—This book gives you the information that represents the collection of years and the expenditure of thousands of dollars. Contains complete directions of making everything from simple glues and adhesive to the tanning of leather, the making of photographic materials, perfumes, soaps, plating of silver and gold, working of metals, etc. 800 Pages. 10,000 Selected Subjects. Price $3.00. Book Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York.

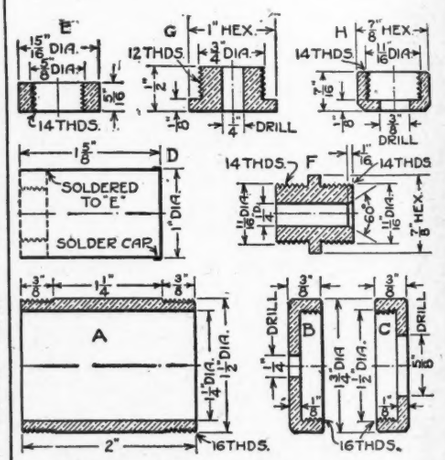
How to Make a Gasoline Strainer for an Automobile

THE illustration shows a gasoline-strainer constructed from scrap taken from the junk-pile of a garage. The strainer was made to obtain relief from carburetor trouble of long duration. The body of the strainer was cylindrical, using an old gear-box bronze bushing *A*, threaded at both ends, and two caps, *B* and *C*, turned down from scraps of 1¾-inch bar stock. These caps were provided with holes of the proper size to fit the union connections. The screen *D*, which was placed on the inside, was also made cylindrical, and was open at the bottom and closed at the top. The brass collar *E* was soldered on the inside of the lower end of the screen. The screen, incidentally, was made of a fine mesh of brass wire screen that had been used in an engine-crank case. The collar *E* was screwed on the union coupling *F*, so that the entire lower union, screen, and lower cap and body formed one unit.



The finished strainer shown in cross-section

The pipe coupling *G*, which was on the carburetor, had its lower portion turned off, after which it was soldered to the upper cap *B*. The lower cap



Dimensions showing how to construct a gasoline strainer for an auto engine

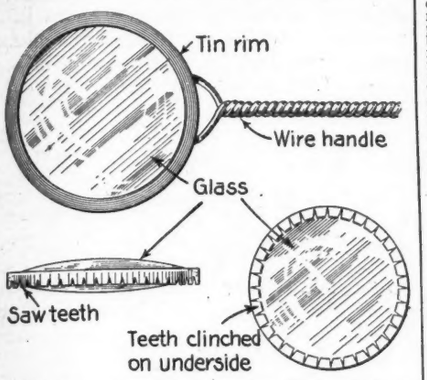
C was in turn soldered to the hexagonal flange of the lower coupling *F*.

Rubber gaskets were placed where shown to prevent any leakage of fuel. While the strainer was made to eliminate the trouble with an old carburetor, it can be used in the gasoline line for removing any dirt that may collect in the tank of an automobile or truck before it enters the carburetor.

—ADOLPH KLEIN.

A Home-Made Holder for a Reading-Glass

AN unmounted reading-glass can be fitted with a suitable holder in the following manner. Procure a tin cover just a little larger in circumference than the glass, cut out the face of it to within about ¼ in. of the edge, and cut notches in the rim as shown. Turn the edges of these projections under, and pierce the rim at two places for two wires. These can be soldered or clinched in place. Twist them to form the handle.



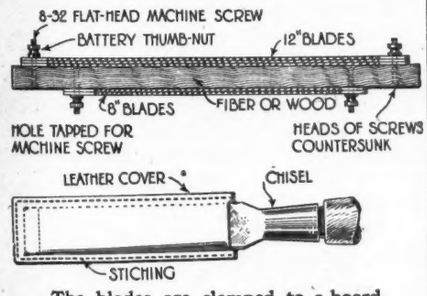
A thin sheet-metal or tin ring with a twisted wire handle for holding a reading-glass

Set the lens in the cover, first laying in a ring of felt or flannel, then bend the saw-teeth projections over against the back of the glass. Give the whole a coat of black enamel for a finish.—L. B. ROBBINS.

For Packing Hacksaw Blades in a Tool-Box

WHEN spare hacksaw blades are carried loosely in a tool-bag or box, they become scattered among the other tools, and when one is wanted considerable time is taken to find it, and then it is often found in pieces. To avoid this trouble, make a holder like the one shown in the illustration. Two sizes of blades can be attached.

Bits, wood chisels, and other edged tools carried by wiremen also receive a good deal of punishment from being jumbled around in a bag, when a very little care is all that is necessary to keep them in good shape. A bit should have a small block of wood screwed on the worm to protect it and the cutting lips. A cover made of leather to slip over the chisel ends gives the needed protection to the cutting edge.—JOHN A. WEAVER.



The blades are clamped to a board and a leather protector is made

AGENTS AND SALESMEN WANTED

WONDERFUL chance for every man and woman, boy or girl anywhere to get wholesale discounts on men's shirts and furnishing goods; also to connect with a large business house and make a steady regular salary and commission. $10 a day taking orders in spare time in your vicinity or on the road in the most dignified and congenial way you ever heard of for the famous nationally advertised Duratex brand; guaranteed six months' wear or replaced free; handsome complete pocket outfit as good as a store free with samples and full instructions; no experience needed; no bother; you only take orders, we do the rest; no delivering; cash commissions in advance; business booming. Lots of men have to have shirts, hosiery, underwear, etc., now that peace has come; lots of repeat orders; start a real, permanent business of your own—even a half hour at noon, an hour at night, brings you $3 to $5 extra money every day; don't take our word. TRY IT, and you'll see. Don't pass this by when it costs you nothing to see if what we say isn't true. The end of every month brings your salary check of $50 to $100. What thousands of others are doing, you can do, too—in exactly the same tried and tested successful way. Write quick for this wonderful chance. Even if you can't take orders you owe it to your pocket book to get wholesale discounts on your own goods. Goodell & Company, 130 Duratex Bldg., New York, largest mail order wholesale haberdashery house in the world.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, New York.

MEN and Women—Become independent—own your business, experience unnecessary selling our $6,000 Accidental Death, $30.00 Accident, $25.00 Sick Weekly Benefits. $10.50 yearly, half amounts $5.50. Guaranteed steady income from renewals. $250,000 deposited Insurance Department. Registration Dept. S., Newark, N. J.

ENORMOUS profits applying transfer monograms to automobiles, trunks, bags, etc. Easily and quickly applied to anything. No experience. No paints or laborious hand lettering. Samples free. Wagner Company, Corona, New York.

VULCANIZING auto-tires growing profitable business, especially now. Easy to learn. Instruction book $1. Plants $50. up. Catalog free. Equipment Company, 372 8th Street, Cincinnati, Ohio.

YOU can make good durable paints and varnish, 25c gallon. Emmelmann Bros. Mfg. Company, Dep't A, Indianapolis, Indiana.

"RADIO" Luminous Paint for resale. Big demand—big profits. Trial can, 50c delivered. American Luminous Products Co., Huntington Park, California.

AGENTS: Our specialties are great money savers for housekeepers. Easy sales; big demand. Immense profits for you. Write Fisher Co., 200, Hannibal, Missouri.

$1,000 per Man per County; Strange invention startles world—agents amazed. Ten inexperienced men divide $40,000. Korstad, a farmer, did $2,200 in 14 days. Schleicher, a minister, $195 first 12 hours. $1,200 cold cash, made, paid, banked by Stoneman in 30 days; $15,000 to date. A hot or cold running water bath, equipped for any home at only $6.50. Self-heating. No plumbing or waterworks required. Investigate. Exclusive sale. Credit given. Send no money. Write letter or postal today. Allen Mfg. Co., 476 Allen Bldg., Toledo, Ohio.

REMARKABLE Stretching Cuff Links—permit cuffs to be raised over elbows quickly, without unbottoning. Durable, invisible, everlasting. Big profits for competent district agents selling direct to wearers. Flexo, P. S. Sheboygan, Wisconsin.

MEN or Women—Enormous profits selling Duo Guaranteed Products. Easy sales at every house. All or spare time. Outfit Free. Write quick. Duo Company, Dept. H66, Attica, New York.

OFFICIAL endorsed war book, maps, charts and diagrams. Unique copyrighted service insert for soldiers' photograph, regiment and military record. Sells like hot cakes to soldiers and friends regardless other war books. Endorsed by highest U. S. Military Official. American, Canadian, British, French and Italian official photographs. Complete and authentic, low price. Agent's profit $1.10 to $1.50. Big premiums extra. Prompt shipment. Freight paid. Credit given. Thrilling battle scenes, wonderful airplanes, Zeppelins, submarines, torpedo boats, tanks and battleships. Hun atrocities, poison gas and liquid fire. Send 10 cents for postage on magnificent free outfit. H. L. Baldwin Company, 314-W, Rockefeller Building, Cleveland, Ohio.

HISTORY of the World War. Most complete and official book published. Best terms. Credit given. Biggest outfit free. Write quick. Ziegler Company, 3G East Harrison, Chicago.

$40 to $100 a week. Free samples. Gold sign letters anyone can put on windows. Big demand. Liberal offer to general agents. Metallic Letter Company, 400 North Clark, Chicago.

AGENTS: Quick seller—big profits. California Rosebeads selling like hot-cakes. Women wild about these beads. Write today. Mission Bead Company, X2819 W. Pico, Los Angeles, California.

WANTED: live agents for More-Miles Gas Tablets; $7.50 per day. Write for proposition. John A. Martin, Aberdeen, South Dakota.

WE make special contracts for exclusive territory with high class educated men who may earn $3000 to $6000 yearly selling our Visual Instruction Equipment to schools and libraries. References and cash deposit guarantee required. Underwood & Underwood, 417 5th Avenue, Dept. P.S., New York.

MAIL-ORDER dealers and agents wanted to handle staple products. American Chemical Company, 640 Elmira Street, New Orleans, Louisiana.

1919 LINE of Globe Transfer Initials for monogramming automobiles just off press; exceptional profits to agents and salesmen. Samples and display board 10c. Particulars free. Globe Decalcomanie Mfgrs., Jersey City, New Jersey.

GREATEST history of World War. Complete details of great battles—600 pages; 100 striking illustrations—only $2.00; 50% commission. Send 10c postage on free outfit. H. J. Smith, Publisher, 1024 Ludington Building, Chicago.

THE fastest selling history of the World War is by Francis A. March, brother of General Peyton C. March, the highest officer in the United States Army. Complete—800 pages illustrated—official photographs. This is your chance to make $500.00 per month. Free outfit. Victory Publishing Company, 429 South Dearborn, Chicago, Illinois.

PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

LIBERTY Policy, the very latest in Insurance, covers all accidents and sickness. Every occupation insurable, men and women, 16 to 70 years. $5,000 death and $25.00 weekly costs $15.00 yearly. Thrift Policy, paying half benefits, cost $7.50 yearly. Special benefits covering farmers. Policies also at $10.00 and $5.00 premiums to meet low-rate competition. Leather wallet enclosing $100 Identification Certificate with each policy. Attractive agency openings with continuous renewal commission. Assets $2,696,258.27. Founded 1907. Southern Surety Company, 308 Walnut Street, Philadelphia, Pa.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stalbrite Company, 1115 Second Avenue, New York.

SALESMEN—City or Traveling. Experience unnecessary. Send for list of openings and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment service rendered Members. National Salesmen's Training Association, Dep't 126 B, Chicago, Illinois.

MINUTES Pay Dollars, demonstrating new $10.00 Adding Machine. Wonderful invention. Adds, subtracts, multiplies. Work equals $300 machine. Five-year Guarantee. Sells everywhere. Splendid profits. Write Quick for trial offer and protected territory. Dept. O, Calculator Corporation, Grand Rapids, Michigan.

AGENTS seeking first class auto accessory, see Hydronizer under "Automobiles and Accessories."

EASY, pleasant work for Mechanics, Shop Men, Clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Co., 27 Bar St., Canton, Ohio.

WONDERFUL Adding Machine—Seven column capacity—retails for one dollar. Sells itself everywhere. Most offices purchase several. Sensational agency proposition. L. J. Leishman Co., Dept. F, Ogden, Utah.

AMERICAN Military Styles are all the rage in men's tailored to measure suits this season. Easiest to sell: everybody wants them. Far ahead of all others in real class and beauty. Lowest prices—less than common ready-made suits. Our agents are coining money. You can earn $10 daily. Send for full particulars, terms and sample book of styles and patterns. American Woolen Mills Co., Dept. A-51, Chicago, Illinois.

QUICK selling, newly patented, universally useful invention. Sells any time, anywhere, anybody. Week's supply can be carried in pockets. Costs 3c each, retails for 10c. Fine sideline opportunity. Send 10c for sample and literature. H. G. Martin, 51 Cliff Street, New York City.

WINDOWEDGE—Stops rattling windows; keeps out cold; worth dollars, sells for dime. Big seller. Moore Company, 413 Jerome Avenue, Cincinnati.

MEN of Ability—To represent manufacturer direct, selling Sales and Order Books. Liberal commission. Wirth Sales Book Co., Dept. P. S., Chicago.

NINETY Per Cent of Your Calls Turned into Sales. Wonderful Enthusiasm Follows Every Demonstration! Write at Once for Full Particulars of Our Line of Eradium (Luminous) Articles. Startling! Mysterious! Everlasting! Novel! They Shine in the dark. Crucifixes, House Numbers, Bulbs, Match Boxes, Pictures, Switch Plates. Sole Manufacturers. The Pioneer Corporation, 1263 W. 63rd, Chicago.

AGENTS—Steady Income. Large manufacturer of Handkerchiefs and Dress Goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Whole or spare time. Credit given. Send for particulars. Freeport Mfg. Co., 24 Main Street, Brooklyn, New York.

OUR New Inventions earn you steady income. Canvassers, County Rights, Salesmen and Promoters write. Adam Fisher Mfg. Co., 183G, St. Louis, Missouri.

AGENTS: Big money selling great household invention. Sample 25c. Particulars free. Webster & Company, 2935 North Clark Street, Chicago.

$10 DAILY refinishing chandeliers, brass beds, automobiles, by new method; producing amazing results; no capital or experience necessary. Particulars free. Gunmetal Co., Avenue F., Decatur, Illinois.

DURING spare time sell your friends our hosiery and underwear for their own use. Many salesmen are making $5.00 a week upwards without interfering with regular line. C. & D. Company, Dept. 10, Grand Rapids, Michigan.

WERE You Ever Offered a Grocery Store? Our Proposition is Better. Let us tell you how you can handle Flour, Canned Goods, Provisions, and entire line of groceries, as well as Paints, Roofing, Stock, Foods, Automobile and Machinery Oils and Greases. No rent to pay. No investment in stock. Large orders taken from samples. Goods of guaranteed and proven quality. Selling experience not necessary. Very profitable work for "workers." Address Hitchcock Hill Company, Dept. 220, Chicago, Illinois. Reference: Any bank or express company.

INSYDE Tyres, inner armour for Automobile Tires, prevent punctures and double mileage of any tire. Liberal profits. Details free. American Accessories Co., Dept. 97, Cincinnati, Ohio.

MAKE and Sell Your Own Goods. Machinery unnecessary. Expert Chemists advise. Special attention to beginners. Write for Formula Catalog. Elmer Mystic Company, Washington, D. C.

NEW Check Protector. Good agent's proposition. Sample 25c. Brackbill, 1307 McFerran Street, Philadelphia.

PATENTS. Write for Free Illustrated Guide Book. Send sketch or model for free opinion of its patentable nature. Highest References. Prompt Attention. Reasonable Terms. Victor J. Evans & Co., 174 Ninth, Washington, District of Columbia.

AGENTS 200% profit. Wonderful little article. Something new; sells like wildfire. Carry right in pocket. Write at once for free sample. Albert Mills, Mgr., 6147 Third Street, Cincinnati, Ohio.

AGENTS—either sex—make $15.00 to $30.00 daily selling Great War Book. Complete history of War illustrated with scores of stirring photographic battle scenes, maps, etc. Agents outfit free. Send 10c for postage. N. D. Thompson & Company, Fullerton Building, St. Louis, Missouri.

BIG money selling Fletcher's Non-Alcoholic Food Flavors and Consurvo for baking without eggs. Two big sellers—particulars free. Consurvo (equals 12 eggs), 10c. Fletcher Production Company, 315 South Clinton, Chicago.

AGENTS—$60 a week to travel by automobile and introduce our 200 candle power coal-oil lantern. Write for particulars of our free auto offer. Thomas Co., 861 North St., Dayton, Ohio.

233% PROFIT selling Jubilee Spark Intensifier. Banishes spark plug trouble. Sells like wild-fire. Exclusive territory. Write quick. Jubilee Mfg. Company, Omaha, Nebraska.

SALESMEN and District Organizers with Ford Car to sell Simplex Ford Starters. The only mechanical starter with a reputation of making good. Fits any Ford Car. Sells for $15.00. Write for agency. Box 350, Simplex Mfg. Company, Anderson, Indiana.

RURAL agents with autos, pep and small capital for Lightning Fire Prevention Drive. U. S. Agricultural Bureau, Insurance Companies, State Fire Marshalls Advocating Lightning Protection for farm properties. R. H. Company System is guaranteed 100% efficient. Districts being assigned. Healthful, profitable work. Qualify now under our instructions. Reyburn, Hunter, Foy Company, 815 Broadway, Cincinnati, Ohio.

DISTRICT sales managers wanted to call on jobbers and dealers only for Klincher Tong Grip Tire Tool. Changes clincher tires instantly. Retails $3.00. Only investment required is sample. Christall of Indiana made $30. first day and over $200 first week. Fast seller. Big demand. Nationally advertised. No competition. Send for our proposition. This is not an agents proposition. Klincher Tool Mfg. Company, Minneapolis, Minnesota.

NEW $2.50 automatic adder. Excellent profit. 10 daily easy. No competition. Sells everyone having adding to do. Bassett 1458M, Hollywood Avenue, Chicago.

HISTORY of World War, by Francis A. March. Introduction by General March. Biggest pictorial book. Your profit averages $1.25 each. Outfit free. Historical Book Company, Chicago.

WORLD'S fastest selling auto accessory. County distributors wanted; write today. G. L. W. Spring Oiler Company, San Diego, California, U. S. A.

AGENTS—New Carburetor for Ford Cars. Simple, not a moving part, installed in thirty minutes, guaranteed to double your mileage and start in zero weather without heating or priming. 15 day Free trial. Write, U. & J. Carburetor Company, 505 J., Jackson Boulevard Chicago.

MANUFACTURE and sell your own Toilet Articles, for particulars, Commercial Laboratory, Box 1316, Memphis, Tennessee.

HELP WANTED

MEN wanted to make toy soldiers, army, navy and other toys. Home workers on small scale, manufacturers on large scale. Greatest chance for industrious people for independent business. Enormous demand and future in "American-made-toys." This new American work stands out conspicuously Factories have been established, people trained, machinery made with energy and success. Dealers don't want to handle any others except "American-made." We buy these goods all year, paying fixed prices. Experience or tools not necessary Hundred and more made complete per hour Casting form outfits $3.00 up. Booklet and information free. Toy Soldier Manufacturing Company, 32 Union Square, New York.

MEN—Age 17 to 45. Experience unnecessary Travel; make secret investigations, reports. Salaries, expenses. American Foreign Detective Agency, 321 St. Louis.

WRITE Photoplays. $50 each. Experience unnecessary, details free to beginners. Producers' League, 194, St. Louis.

EARN $900 to $1800 per Year. Government Railway Mail, Post Office and other "exams" coming. Prepare under Former Civil Service Examiner. Book free. Patterson Civil Service School, Box 3019, Rochester, N. Y.

BE a detective. Excellent opportunity, good pay, travel, Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

BE a Mirror Expert, $3-$10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free prospectus. W. F. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

BE a Finger Print Expert—$25 to $50 a week in this new and fascinating profession. Write—find out how you can learn at home to supply the big demand for finger print experts in banks, big factories, detective agencies, etc. Special limited offer—write while it lasts. University of Applied Science, Room 9202, 1810 Wilson Avenue, Chicago, Illinois.

INVENTORS. Send sketch and description of your invention for advice regarding patent protection. Twenty years experience. Our hand-book on patents is sent free on request All communications strictly confidential. Write us today. Talbert & Talbert, Patent Lawyers, 4101 Talbert Bldg., Washington, D. C.

DETECTIVES make big money. Be one. Write American School of Criminology, Detroit, Michigan.

MEN—women—girls, wanted by U. S. Government. Clerks at Washington—Railway mail clerks—City postal clerks and carriers. $1,100 year. List positions free. Write immediately Franklin Institute, Dept. A-50, Rochester, New York.

GET a Government position through us. Position or money back guaranty. Thousands of men and women, 16 to 60, needed in Washington and elsewhere for the years of "Reconstruction" ahead. We'll coach you quickly by mail for Civil Service examination and appointment. Permanent; easy hours, paid vocations; higher salaries. Our free Book "RG" gives list of positions; Write for it. Washington Civil Service School, 2027 Marden Building, Washington, District of Columbia.

PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

MEN wanted to become chauffeurs. $35 week. Sample lessons free. Franklin Institute, Dept. A803, Rochester, New York.

BUSINESS OPPORTUNITIES

ENTER a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks, at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 15 Back Bay, Boston, Massachusetts

EXPERT Chemist will furnish Formula and Trade Secrets in all lines. Lists free. W. L. Cummings, Ph. D., 217 Standard St., Syracuse, New York.

MAKE Die-Castings. Sketch, Sample, Booklet and proposition 12c. R. Byrd, Box 227, Erie, Pennsylvania.

WRITE for newspapers and magazines. Big Pay. Experience unnecessary, details free. Press Reporting Syndicate, 4005, St. Louis.

WAR humane hospital essentials; wounded sailors—soldiers. Vital labor associate to produce. Hanlon, 121 Arch, Philadelphia.

I MADE $30 a week, easy money, evenings, home. Free booklet explains. Send stamp. Al Scott, Cohoes, New York.

YOUR idea wanted. Patent your invention. I'll help you market it. Send for 4 free books, list of patent buyers, hundreds of ideas wanted, etc. Advice free. Patents advertised free. Richard B. Owen, Patent Lawyer, 44 Owen Bldg., Washington, D. C., or 2276Z Woolworth Bldg., New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

DOLLARS Yearly in your backyard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. C. Metz, 313 East 89th, New York.

RAISE Guinea Pigs for us. We buy all you raise. Pay better than poultry. Contract, particulars, booklet how to raise free. Cavies Distributing Co., 3141 Grand Ave., Kansas City, Missouri.

MULTIGRAPH Letters build business. Most economical and effective advertising. Printing. Addressing. Low rates, careful work, service. Multigraph-Peerless Letter Company, 241 Fourth Avenue, New York.

FREE—3 Months to get acquainted; devoted to news and opportunity. The Western Miner, 2541 W. 37th Ave., Denver, Colorado.

BUY and exploit practical inventions. Trade for property. Form companies. Sell county rights. Adam Fisher Mfg. Co., 183D, St. Louis, Missouri.

SILVERING Mirrors—Exclusive Tartaric method opens enormously profitable business. Booklet free. P. Barstow, 514 23rd Street, Oakland, California

GET our special confidential home agency offer on the Choraleon Phonograph—the wonderful new record player. Plays any standard record Looks just like the $150 and $200 kind. Low wholesale price to one confidential agent only in each town. No canvassing or soliciting. Our plan tells you how to easily make money without effort. Write quick. Be first to get this splendid offer. The Choraleon Company, 2201 Monger Building, Elkhart, Indiana.

PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

ASSIST in the reconstruction of Belgium. The Belgo-American Corporation, Ltd., 329, High Holborn, London, W. C. I. England, wishes to make arrangements with American firms for pushing their business in Belgium and in the Belgian Colony of the Congo. Write and send catalogues.

AGENTS wanted to sell chewing gum ball vending machines. 59W Drexel Building, Philadelphia, Pennsylvania

DOLLAR addressed UmakeM, Fleven UmakeM Building, Fifth Avenue, New York, brings designs, tools and materials for starting UmakeM business at home.

BUSINESS of your own. Spare time. How to make and sell souvenirs, novelties, etc. Book only 20c. O. Twitchell, West Milan, New Hampshire.

STAMPS AND COINS

208 Genuine Foreign Stamps—Mexico War Issue' Venezuela, Salvador and India Service, Guatemala, China' etc., only 10c. Finest Approval Sheets 60% to 80% Agents Wanted. Big 72-page Lists Free! We Buy Stamps Est. 25 years. C. E. Hussman Stamp Co., Dept. 55, St. Louis, Missouri.

FREE, 25 different United States with 60% approvals. Enclose 3c. 100 different United States 25c. Seidenberg, Beecher, Illinois.

OLD Coins. Large Fall Selling Catalogue of coins for sale free. Catalogue quoting prices paid for coins, ten cents. William Hesselein, 101 Tremont Street, Dept. P, Boston, Massachusetts.

FREE, 60 different stamps including Newfoundland, China, Japan, Mexico, etc., to applicants for our high grade approvals. Send 3c stamp for return postage. The Edgewood Stamp Company, Dept. M., Milford, Conn.

STAMPS, 61 All Different, 3 cents. Mention paper. Quaker Stamp Co., Toledo, Ohio.

$2 to $600 paid for hundreds of old coins dated before 1895. Send 10 cents at once for new illustrated coin value book. Size 4 x 7 It may mean your fortune. Clarke & Co., Coin Dealers, Box 76 LeRoy, N. Y.

PACKET "A" 100 varieties foreign stamps, 20c. F. J. Pope, Charlotte, Vermont.

17 Varieties Hayti Stamps 20c. List of 7000 varieties, low priced stamps free. Chambers Stamp Co., 111C, Nassau St., New York City.

CALIFORNIA gold, quarter size, 27c; $\frac{1}{2}$ size, 53c; dollar size, $1.10. U. S. Three-cent piece and catalogue 10c. Norman Shultz, King City, Missouri.

STAMPS, 50 Varieties, Transvaal, Brazil, Peru, Cuba, Mexico, etc., and Album, 10c. 1,000 mixed, 40c. 60 different U. S., 25c. 1,000 hinges, 10c. List free. I buy stamps. C. Stegman, 5949 Cote Brilliante, St. Louis, Missouri.

STAMPS! 50 different Belgium (large bi-color) China, Jamaica, Portugal, Venezuela, etc., 10c; 1,000 well mixed, 40c; 100 varieties U. S., 50c; 1,000 hinges, 10c; Agents wanted; 50%. List free. I buy stamps. L. B. Dover, Overland, Missouri.

105, China, etc., Stamp Dictionary, list 2c. Album, 500 illustrations, 3c. Bullard, Station AA, Boston.

"SPECIAL" packet 10c. Rare stamps on approval. Sears-Nelson, Oak Park, Illinois.

STAMPS—12 different from warring nations, 10c; 10 different foreign coins, 15c; 10 Uruguay stamps for 10c. Lists free. Toledo Stamp Co., Toledo, Ohio.

FREE: 25 different United States Stamps to approval applicants. Postage 3c. Jukes, 4220 Walnut, Philadelphia.

STAMPS—125 foreign—3c; 350 different—30c. Approvals 50%. Benjamin Forbes, 160 Devilliers, Pittsburgh, Pennsylvania.

BOOKS AND PERIODICALS

INSTRUCTION Book (for shop use) on Vulcanizing Auto-Tires, $1. Tire Equipment Company, 368 8th Street, Cincinnati, Ohio.

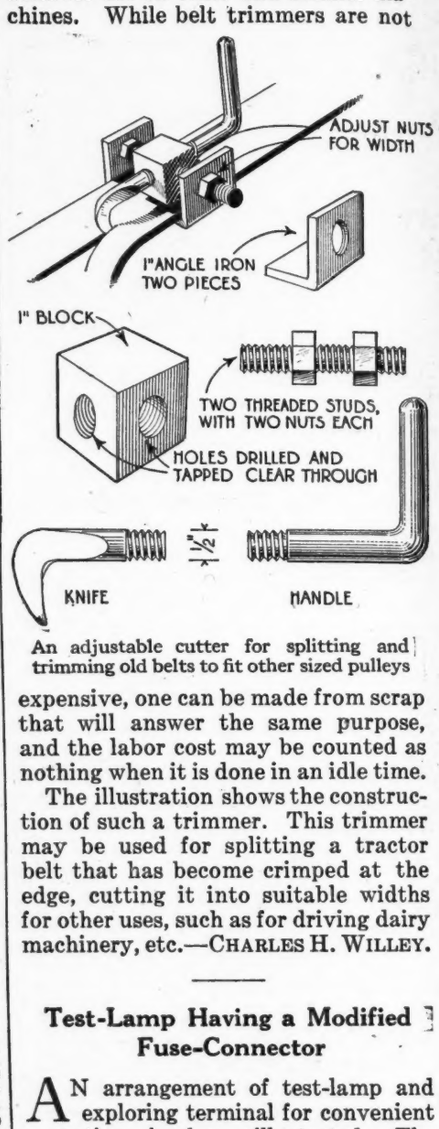
PROSTATOLOGY is our free booklet on prostate gland disorders, see our ad under "For Men and Women." The Electrothermal Company, 102 Colt Building, Steubenville, Ohio.

USED Books. Bargains. Catalog. Hignes K-2441 Post. San Francisco. (Books Bought.)

READERS of Popular Science Monthly—here's your chance: We have on hand a limited number of bound volumes: No. 88—January to June, 1916; No. 89—July to December, 1916; No. 91—July to December, 1917. These copies are beautifully bound in heavy gray covers with dark green backings, containing the words "Popular Science Monthly," the volume number and months included. Each volume comprises 960 pages, 1306 articles and 2,082 pictures. Just the thing for your library. A ten page index enables you to find in a moment any article or picture desired. Contain no advertising whatever. At the present cost of printed matter, these volumes should retail at $5.00. You can secure them now for $2.50 each postpaid. Book Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York City.

A Home-Made Belt-Trimming Tool

THE use of machinery, especially to the amount installed on the modern farm, calls for many belts, and these in time wear out. Many an idle hour in winter may be spent in trimming, cutting, and remaking old belts for use on other and smaller machines. While belt trimmers are not



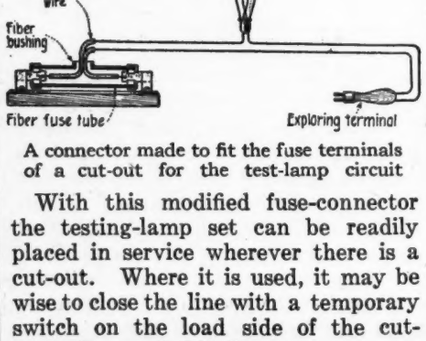
An adjustable cutter for splitting and trimming old belts to fit other sized pulleys

expensive, one can be made from scrap that will answer the same purpose, and the labor cost may be counted as nothing when it is done in an idle time.

The illustration shows the construction of such a trimmer. This trimmer may be used for splitting a tractor belt that has become crimped at the edge, cutting it into suitable widths for other uses, such as for driving dairy machinery, etc.—CHARLES H. WILLEY.

Test-Lamp Having a Modified Fuse-Connector

AN arrangement of test-lamp and exploring terminal for convenient operation is here illustrated. The flexible lamp-cord and the lamp, which also serves as a current limiting device, and the exploring terminal can be plugged in series with the supply by using a fuse-connector, as shown.



A connector made to fit the fuse terminals of a cut-out for the test-lamp circuit

With this modified fuse-connector the testing-lamp set can be readily placed in service wherever there is a cut-out. Where it is used, it may be wise to close the line with a temporary switch on the load side of the cut-out.—PETER J. M. CLUTE.

Combining Initial Letters in a Bag-Tag

A VERY useful and ornamental piece of work in the more precious metals is a bag-tag. For one who can design and create ideas on paper the work is very easy. There are several

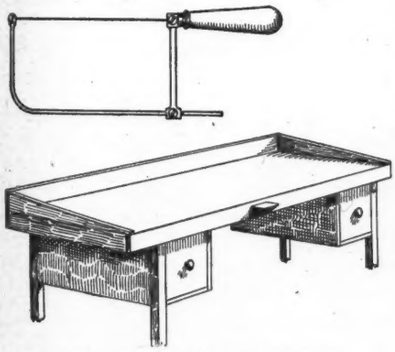
Monograms as they are cut from metals for making a bag-tag

arrangements of letters shown which will assist in giving ideas of combining other letters.

A design is first drawn on paper accurately, then traced on transparent paper—tracing paper, as it is called. The tracing is placed over the drawing and held firmly in place with push-pins or thumb-tacks, and the lines of the original drawing are traced on it. This tracing is used for transferring the design to the metal.

The metal, in this instance, is silver of about 18-gage. The tracing is laid on the silver, with a carbon sheet between them, the dark part of the paper being against the metal. A hard and sharp pencil, or a stylus, is used to run over the lines. The lines thus transferred to the metal are easily erased, and one must use care in handling the piece after the tracing is made.

To cut out the parts, a jeweler's saw, with a few fine steel blades, is necessary. Use about No. 1 saw blade. The sawing is done on a small block projecting from a bench. A jeweler's bench is shown in the illustration. As the amateur will not have such a bench, a piece of board clamped to the table- or bench-top will serve the same purpose.



A jeweler's bench, used for beating and shaping articles in metal

The sawing should be done as close to the line as possible. Be careful not to run into line, for this mistake will cause considerable trouble.

In the monogram ADA the sawing is done along the outside first, the lines being finished with fine files. Saw with a slow up-and-down motion. The saw should be so placed in the frame that it cuts only with the down stroke.

"Here's an Extra $50, Grace —I'm making real money now!"

"Yes, I've been keeping it a secret until pay day came. I've been promoted with an increase of $50 a month. And the first extra money is yours. Just a little reward for urging me to study at home. The boss says my spare time training has made me a valuable man to the firm and there's more money coming soon. We're starting up easy street, Grace, thanks to you and the I. C. S.!"

Today more than ever before, money is what counts. The cost of living is mounting month by month. You can't get along on what you have been making. Somehow, you've simply got to increase your earnings.

Fortunately for you hundreds of thousands of other men have proved there is an unfailing way to do it. Train yourself for bigger work, learn to do some one thing well and employers will be glad to pay you real money for your special knowledge.

You can get the training that will prepare you for the position you want in the work you like best, whatever it may be. You can get it without sacrificing a day or a dollar from your present occupation. You can get it at home, in spare time, through the International Correspondence Schools.

It is the *business* of the I. C. S. to prepare men in just your circumstances for better positions at better pay. They have been doing it for 27 years. They have helped two million other men and women. They are training over 100,000 now. Every day many students write to tell of advancements and increased salaries already won.

You have the same chance they had. What are you going to do with it? Can you afford to let a single priceless hour pass without at least finding out what the I. C. S. can do for you? Here is all we ask—without cost, without obligating yourself in any way, simply mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7622, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

ELECTRICAL ENGINEER	SALESMANSHIP
Electric Lighting and Rys.	ADVERTISING
Electric Wiring	Window Trimmer
Telegraph Engineer	Show Card Writer
Telephone Work	Sign Painter
MECHANICAL ENGINEER	Railroad Trainman
Mechanical Draftsman	ILLUSTRATING
Machine Shop Practice	Cartooning
Toolmaker	BOOKKEEPER
Gas Engine Operating	Stenographer and Typist
CIVIL ENGINEER	Cert. Pub. Accountant
Surveying and Mapping	TRAFFIC MANAGER
MINE FOREMAN or ENG'R	Railway Accountant
STATIONARY ENGINEER	Commercial Law
Marine Engineer	GOOD ENGLISH
Ship Draftsman	Teacher
ARCHITECT	Common School Subjects
Contractor and Builder	Mathematics
Architectural Draftsman	CIVIL SERVICE
Concrete Builder	Railway Mail Clerk
Structural Engineer	AUTOMOBILE OPERATING
PLUMBING AND HEATING	Auto Repairing
Sheet Metal Worker	Navigation
Textile Overseer or Supt.	AGRICULTURE
CHEMIST	Poultry Raising
	Spanish
	French
	Italian

Name_____

Present Occupation_____

Street and No._____

City_____ State_____

Be an Artist

Comics, cartoons, commercial, newspaper and magazine illustrating. Pastel crayon portraits and Fashions. Earn $25 to $200 a week. By our simple method your talent is quickly developed without interfering with present work. By Mail or Local Classes. The largest practical art School in the world. Write for full particulars and list of successful pupils, illustrated prospectus, etc. Endorsed by newspapers and magazines.
ASSOCIATED ART STUDIOS, 58D, Flatiron Building, New York, N.Y.

Delivered To You FREE

Your choice of 44 styles, colors and sizes in the famous line of "RANGER" bicycles, shown in full color in the big new Free Catalog. We pay all the freight charges from Chicago to your town.

30 Days Free Trial allowed on the bicycle you select, actual riding test in your own town for a full month. Do not buy until you get our *great new trial offer* and low Factory-Direct-To-Rider terms and prices.

TIRES LAMPS, HORNS, pedals, single wheels and repair parts for all makes of bicycles at half usual prices. No one else can offer such values and such terms.

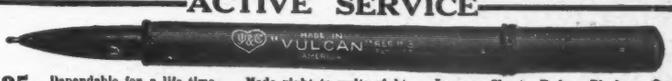
SEND NO MONEY but write today for the big new Catalog. It's free.

Rider Agents Wanted

MEAD Cycle Company Dept. 109 Chicago

The **Classified Advertisements** are on pages 106-110. Turn to them now and learn what rare opportunities are presented for legitimate and mutually profitable business.

ACTIVE SERVICE



$1.25 Dependable for a life time. Made right to write right. Long or Short—Red or Black. Absolute necessity to any business man or woman. Unequaled for general writing, billing, ruling and manifolding. Made of pure vulcanized rubber with non-corrosive, durable writing point. Lock-Cap prevents leaking. Extra size, 8 in., black only, $1.50. Your name in gold inlay, 35c. FREE: Liberal supply of ink with retail orders. Agents wanted. Good profits. **$1.25**

J. L. ULLRICH & CO. 27 Thames St., New York

PATENTS

IF YOU HAVE AN INVENTION AND DESIRE TO LEARN HOW TO SECURE A PATENT, send for Our Guide Book, **HOW TO GET A PATENT,** sent Free on request. Tells our Terms, Methods, etc. Send model or sketch and description of your invention and we will give our opinion as to its patentable nature.

RANDOLPH & CO.
130 F St., N. W., Washington, D. C.

NAME.....
STREET.....
CITY..... STATE.....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—**"Inventions and Trade Marks, Their Protection and Exploitation"** and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. **A postal will do—it is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.
201 Patent Dept., WASHINGTON, D.C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c.

PATENTS

INVENTORS: Send us sketches of your invention and a description of the device for advice in regard to the best way of obtaining patent protection. Our practical experience covers a period of twenty years. Our hand-book on patents is sent free on request. All communications strictly confidential. Write us today.

TALBERT & TALBERT
Patent Lawyers
4621 Talbert Bldg., Washington, D. C.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE
274 OURAY BLDG. WASHINGTON, D.C.

DO NOT LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form **"Evidence of Conception"** to be signed and witnessed. Establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of their inventions. Terms reasonable. The form **"Evidence of Conception,"** sample, instructions relating to obtaining of patent and fee schedule sent upon request. Ask for them,—a postcard will do.

AMERICA NEEDS YOUR IDEAS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection, and the commercial development of his proposition. Send sketch or model, and description for advice as to cost, probable patentability, etc. All preliminary questions gladly answered without charge.

My clients' inventions are given wide publicity through INVENTION AND MANUFACTURING SUPPLEMENT. Sample copy free.

Booklet of valuable information, and form for properly disclosing your ideas, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
6 Owen Building, Washington, D. C. | 2276-D Woolworth Bldg. New York City

PATENTS COPYRIGHTS TRADE MARKS DESIGNS
U.S. PATENTS

Our facilities for securing patents enable us to give prompt and reliable service at reasonable rates. Inventors are invited to write to us regarding questions appertaining to securing patent protection. All matters receive prompt attention. Send for blank form of disclosure to protect your rights until filed in the patent office. Book of instructions and blank forms are free on request.

A. M. BUCK & CO., Patent Attorneys
510 Second National Bank Bldg. Washington, D. C.

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office
NORMAN T. WHITAKER
Lawyer and Engineer
280 Whitaker Bldg., Wash., D. C.
INQUIRIES INVITED

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers

Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2101 Fourth St. Waupun, Wisconsin

To cut out the metal inside of the letters, it is necessary to drill a small hole in the waste material in order to insert the saw-blade. Fasten it in the frame, and saw up the lines on the inside.

When the inside sawing is complete, finish with fine files. Such files may be purchased in various shapes, and will reach the most difficult corners. Any sharp edges in evidence should be removed. This is accomplished be using a very fine, flat file, barely touching the surface enough to remove the bur. When this is complete, a final finish is given by using very fine emery- or crocus-cloth. The cloth is laid on a flat surface and the metal rubbed across it until all the coarse marks are removed.

Emery-cloth leaves a very good dull finish on pieces of this kind, and is often used satisfactorily. More complicated work will require polishing and oxidizing. A leather strap is put through the slot at the top of the tag, and it is all ready for use.—H. R. SORENSEN.

An Arm-Band to Hold a Lineman's Tools

THE progress of the "safety first" movement that is now sweeping over the country has been remarkably rapid. It has caught the attention and interest of the electric lineman, who is always endangering not only his own life but also that of pedestrians

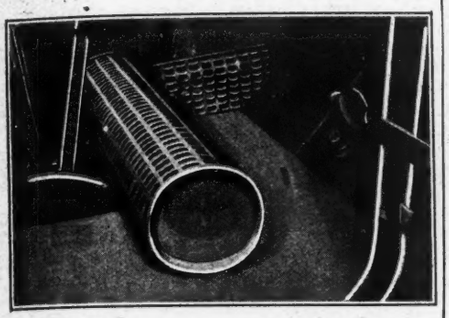
Tools are hung by short chains to the belt, and the same chain holds the tool to the wrist when it is being used

by dropping tools. To avoid occurrences of this kind, the safety devices shown in the accompanying illustration were tried out, and they proved successful.

The tools are fastened to the lineman's belt by means of a chain not more than 5 in. long. This length avoids any short-circuiting. Each tool can be easily removed from his belt and fastened to the band around his wrist.—ERNEST SCHWARTZ.

How to Make a Heater for an Automobile

THE automobile heater here illustrated was made from a piece of 4-in. steam-pipe 2 ft. 2 in. long, with threads cut on both ends so that they could be closed with two 4-in. caps. A 1½-in. hole was drilled near each end of the pipe so that one hole was straight down and the other in a horizontal position. The pipe was covered with a piece of perforated sheet metal about 2½ ft. long and 20 in. wide, rolled



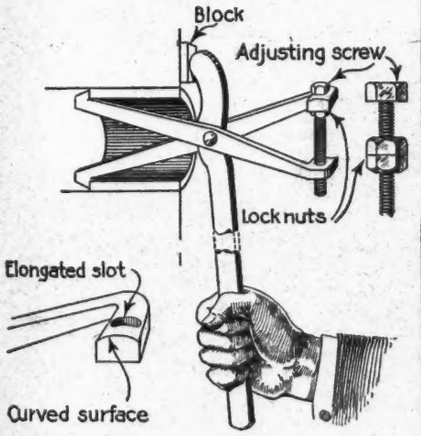
The heater placed on the floor of the automobile to warm the feet on a cold day

in a cylindrical form. Holes were cut in the perforated cover for the projecting nipples that were turned into the 1½-in. holes.

A V-shaped notch was cut into the exhaust-pipe between the engine and the muffler, and a "clamp-on" cut-out valve used to make the connection. The connecting pipe was made from 1½-in. flexible tube. For heat in winter, plug up the exhaust and turn the valve.—JOHN PETERS.

A Home-Made Tool for Removing Different Sized Bushings

THE following home-made device is adjustable to a number of different sized bushings. It is quite simple to make and easy to use. The drawings show its construction and operation. The arms are made of machine steel and the lever of mild steel. The



An adjustable pair of tongs for pulling bushings from their housings by hand

legs are adjusted by a cap screw, a long hole being cut in the upper end and the top surface curved so that the parts work freely.—CHARLES H. WILLEY.

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and returned to us together with model or sketch and description of the invention, and we will give our opinion as to its patentable nature.

Our Illustrated Guide Book, HOW TO OBTAIN A PATENT, sent Free on request. Contains full instructions regarding Patents, Trade-Marks, Foreign Patents, Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Patent Practice and Procedure, and Law Points for Inventors.

Highest References *Prompt Service* *Reasonable Terms*

FREE COUPON!

VICTOR J. EVANS & CO., Patent Attorneys

New York Offices 1001 Woolworth Bldg. *Philadelphia Offices* 135 S. Broad Street *Pittsburgh Offices* 514 Empire Bldg.

Main Offices: 760 9th Street, N. W., WASHINGTON, D. C.

GENTLEMEN: Please send me FREE OF CHARGE your Book as described above.

NAME.....ADDRESS.....

Deafness

Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums

"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable. Write *today* for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.

WILSON EAR DRUM CO., Incorporated
523 Inter-Southern Bldg. LOUISVILLE, KY.

PATENTS and Trade Marks

Send sketch or model for actual search and report. Write for Booklet of instructions on patent practice and procedure. Prompt personal service....

Geo. P. Kimmel
Patent Lawyer
39-N Oriental Bldg., Washington, D. C.

PATENTS
LACEY & LACEY
Attorneys-at-Law — Patent Practice Exclusively
Solicitors of
U. S. and Foreign Patents
Trade-Marks, Copyrights.
646 F Street, N.W., Washington, D. C.
Write Us for Our Inventors' Book
PATENT-SENSE
ESTABLISHED 1869

PATENTS PROCURED and TRADE-MARKS REGISTERED
Eighteen Years' Experience. Instructions and Terms on request.
ROBB & ROBB, Attorneys at Law
Specializing in Patent and Trade-mark Practice exclusively
840 Southern Bldg., Washington, D. C.
1336 Schofield Bldg., Cleveland, Ohio.

ARMATURE AND MAGNET WINDING
By Horstman & Tousley
A necessary book for electricians. Full facts and diagrams, $1.50 postpaid.
Popular Science Monthly, 225 W. 39th St., New York

ELECTRICITY MADE SIMPLE A book devoid of technicalities. Simple, plain and understandable. $1.00 Postpaid.
Popular Science Monthly, 225 W. 39th St., New York

PATENTS

Terms Reasonable Highest References Promptness Assured Best Results

Send drawing or model for preliminary examination

ALL BUSINESS GIVEN PROMPT AND PROPER ATTENTION

WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D.C.

DIAMONDS ON WATCHES ON CREDIT

Loftis Solitaire Diamond Cluster Ring

Has the exact appearance of a large handsome Solitaire Diamond that would cost three or four times as much.

Send for Free Catalog

There are over 2000 illustrations of Diamonds, Watches, Jewelry, etc. Whatever you select will be sent, all shipping charges prepaid.

You See and Examine the Article Right in Your Own Hands

If satisfied, pay one-fifth of purchase price and keep it; balance divided into eight equal amounts payable monthly.

Our Catalog shows all the new Watches—15, 17, 19, 21, 23 Jewels, adjusted. Splendid bargains in 25-year guaranteed Watches on credit terms as low as

$2.50 a Month

Looks Like What It Is Intended For—a Large Single Diamond

Splendid Bargains Now Offered at $75, $100, $125 and $150.

EASY CREDIT TERMS

The secret of the rare beauty of the Loftis 7-Diamond Cluster Ring lies in the perfectly matched stones, all the diamonds being uniform in size, quality and brilliancy; mounting is 14 karat solid gold. Very popular.

LOFTIS BROS & CO. 1858

The National Credit Jewelers

Dept. K-871 108 N. State Street

CHICAGO, ILL.

STORES IN LEADING CITIES

MAKE YOUR BIKE A MOTORCYCLE

at a small cost, by using our attachable outfit. Fits any Bicycle. Easily attached. No special tools required.

"Used His Four Years"

Harry A. Hyatt, of Boreas River, New York, writes: "About four years ago I received my motor attachment, and wish to say that I am satisfied with it in every way, for it has certainly given me good service. Anyone wanting a motorcycle or attachment, I would recommend them to the Shaw Manufacturing Co."

FREE BOOK Write today for bargain list and free booklet, fully describing the SHAW Bicycle Motor Attachment. Motorcycles all makes, new and second-hand, $35.00 up.

SHAW MANUFACTURING CO.

Dept. 169 GALESBURG, KANSAS

They don't call him "SKINNY" any more

Why is it that you stay thin? Do you know? How often have you wished that you could cover the bones that show so plainly all over your body—to feel the thrill of that vitalising energy that comes from a fully developed body tingling with health! *You can have it!* It will make a new man of you—full of energy, ambition, and the joy of living. And the beauty of it all is that this precious gift *will cost you nothing!* You have it in the palm of your hands right now! Start NOW and in less than a month you will be well on the way to physical perfection.

How to Make a New Man of Yourself

"How to Gain Weight" is the title of a book written by Bernarr Macfadden, founder of "Physical Culture" magazine. It goes to the very core of the subject and tells you how to gain weight *easily* and *naturally*, without the aid of a drop of medicine. To those who will send us a three month subscription for "Physical Culture," the most unique, helpful and inspirational magazine of its kind published in America, at the regular price of 50c, we will send this valuable book *FREE*. Write TODAY.

PHYSICAL CULTURE PUB. CO.

119 W. 40th St., Suite 860, New York

Build Your Own PHONOGRAPH

It's Easy With Our Help

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

SAVE OVER HALF

Write Today for Our Free Blue Print Offer

Agents wanted for our ready built phonographs

CHORALEON CO.

602 Monger Bldg., Elkhart, Ind.

What Did You Do with Your Old Car?

$300 in Prizes for Ideas

THOUSANDS upon thousands of old automobiles which had been cast into the discard as too old and too incomplete for satisfactory service were seen on the streets during the last six months of 1918, and many are still merrily chugging their way over our thoroughfares, each giving some service to mankind which is better than no service at all. Automobile authorities estimate that it will be at least nine months before all of the factories are turning out cars at their before-the-war rate.

Many remarkable transformations were made in old cars called out of retirement. Here was an old-timer with a chariot-type body fitted with an ingenious kind of closed body for winter use; there, a new carbureter which brought the miles per gallon up from five or six to nine or ten.

Many of the improvements and adaptations are important and practicable enough to warrant their being continued. It is in this belief that the POPULAR SCIENCE MONTHLY has decided to offer the substantial total of $300 in prizes for the three best methods of enabling the old passenger automobile to continue in service until, like the one-horse shay, it falls to pieces in its every part.

Rules of the Contest

ONE—The utilization of the old passenger car may roughly be divided into two main classifications: *a*—The continued use of the vehicle as a mode of transportation; and, *b*—The use of the vehicle to perform some function in a better manner, in less time and more cheaply than the same function can be performed by hand.

TWO—In determining upon the prize-winners, the judges will pass on each classification as of equal importance and will make the awards in the order in which the utilization or adaptation is of the most value or the greatest good to the largest number of people, no matter whether such utilization or adaptation be a mode of transportation or mode of power application.

THREE—The utilization or adaptation submitted for consideration need not have been in actual use, although if it has been put into actual use it will receive the preference as a deciding factor, when, in the opinion of the judges, two or more utilizations or adaptations are of equal value or good to the greatest number of people in all other respects.

FOUR—Contestants are not limited in the number of utilizations or adaptations they may submit. However, only one can win the first prize, one the second prize, and one the third prize. The contest is open to everyone.

FIVE—The utilization or adaptation submitted must be clearly shown in one or more drawings, or photographs with explanatory drawings, if necessary to bring out the method of arrangement or construction. The drawings must be intelligible, although it is not necessary that they be made by a skilled draftsman. Contestants are requested to make any drawings submitted in ink on stiff board rather than in pencil on writing paper. In each instance, the drawings should be as large as may be necessary to convey the idea clearly.

SIX—The contestant's name and address should appear on each drawing submitted. Each drawing or set of drawings on any one idea must be accompanied by a description in which the utilization or adaptation is clearly indicated. This description (preferably typewritten) must be written on one side of the paper. The name and address of the contestant must appear in the upper left corner of the first sheet of the written description.

SEVEN—The description and drawings submitted by any contestant must be received in the office of the POPULAR SCIENCE MONTHLY not later than 12 o'clock noon, Saturday, March 1, 1919. All contributions received after 12 o'clock noon on March 1, 1919, will not be considered in awarding the prizes, but will be returned to the contestant if return postage is sent.

EIGHT—A first prize of $150 will be awarded to the contestant who, in the opinion of the judges, has submitted the utilization or adaptation of an old passenger automobile which is of the greatest value or good to the largest number of people.

A second prize of $100 will be awarded to the contestant who submits the utilization or adaptation next in the order of merit.

A third prize of $50 will be awarded to the contestant who submits the utilization or adaptation which ranks third in merit.

NINE—The winners of the prizes will be announced in the May, 1919, issue of the POPULAR SCIENCE MONTHLY.

TEN—The description and illustration of the utilization or adaptation which wins the first prize will be published in the May issue of the POPULAR SCIENCE MONTHLY, together with the name and address of the winner. Similarly, the second and third prize uses will be published in the June and July issues respectively together with the names and addresses of those winners.

ELEVEN—The judges of the contest will be the editors of POPULAR SCIENCE MONTHLY.

TWELVE—The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish at regular space rates descriptions of utilizations or adaptations which do not win any of the prizes but which they consider of sufficient interest for publication.

THIRTEEN—The full property rights in any utilization or adaptation submitted are retained by the contestant, the only restriction imposed being that defined in Rule 12.

FOURTEEN—If a contestant submits more than one utilization or adaptation, each must be sent as a separate unit.

FIFTEEN—Address the descriptions and drawings submitted to the Motor Contest Editor, POPULAR SCIENCE MONTHLY, 225 West Thirty-ninth Street, New York City.

A Dirt and Refuse Drop in the Kitchen Floor

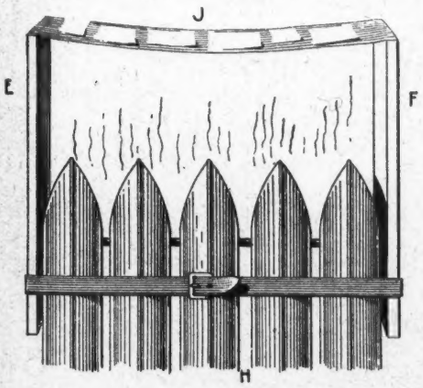
AN ingenious contrivance for taking care of the sweepings in a house was devised by a householder. In one corner of the kitchen floor he

The sweepings are pushed into the opening and drop into an ash-can below

installed a drop similar to a laundry chute, and covered it with a small trap-door. The chute led to an ash-can in the basement. The sweepings are taken out and dumped whenever the can becomes full.—AARON BLOOM.

To Dry Photographic Prints Over a Radiator

THE drying device here illustrated is readily applied to radiator *H* with a strap. It consists of two boards, *E* and *F*, and the piece of cheese-



Upright boards attached to a radiator to hold strip on which prints are dried

cloth *J* stretched between. The prints are placed face down on the cloth. The capacity of the dryer is limited unless several pieces of the cloth are stretched between the boards and used like a series of shelves.

NAME	POSITION	SALARY
John	AUTOMOBILE ENGINEER	$125 A WEEK
	REPAIR MAN	$50 A WEEK
	CHAUFFEUR	$30 A WEEK

Put Your Name On This Pay-Roll

Men like you are wanted for big-pay positions in the fascinating field of automobile engineering. We have made it easy for you to fit yourself for one of these positions. You don't have to go to school. You don't have to serve an apprenticeship. Fifteen automobile engineers and specialists have compiled a spare time reading course that will equip you to be an automobile expert without taking any time from your present work.

AUTO BOOKS

5 Volumes Shipped Free

Now ready for you—an up-to-the-minute five-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Brimming over with advanced information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Written in simple language that anybody can understand. Tastefully bound in American Morocco, flexible covers, gold stamped, 2,400 pages and 2,000 illustrations, tables and explanatory diagrams. A library that cost thousands of dollars to compile but that comes to you free for 7 days' examination.

Partial List of Contents

Explosion Motors
Welding
Motor Construction and Repair
Carburetors and Settings
Valves, Cooling
Lubrication
Fly-Wheels
Clutch
Transmission
Final Drive
Steering Frames
Tires
Vulcanizing
Ignition
Starting and Lighting Systems
Wiring Diagrams
Shop Kinks
Commercial Garage Design and Equipment
Electrics
Storage Batteries Care and Repair
Motorcycles
Commercial Trucks
Glossary

Only 7c a Day

Not a cent to pay in advance. First you see the books in your own home or shop. Just mail coupon and express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books send only $2 in seven days and $2 a month until the special introductory price of $17.80 has been paid. (Regular price $25.00.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This great bargain offer must soon be withdrawn.

Send No Money Now

Don't take our word for it. **See the books without cost.** There is so much profit in this offer for you, that we urge you to waste not a moment in sending for the books. **Put the coupon in the mails today. Send no money—only the coupon!**

FREE!

With every set is included—FREE—a Consulting Membership which gives you the privilege of submitting your perplexing problems to a corps of experts for an entire year. This Consulting Membership regularly sells for $12.00.

American Technical Society
Dept. A-1202, Chicago, Ill.

American Technical Society, Dept. A-1202, Chicago, Ill.

Please send me the 5-volume set, Automobile Engineering, for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2 within 7 days and the balance at $2 a month until the $17.80 has been paid. Then you send me a receipt showing that the $25.00 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after the seven days' trial I will return them at your expense.

Name .....

Address ..... Reference .....

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This Course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

TAKE 10 LESSONS FREE So that you may see for yourself how thorough and complete our training is. We invite you to take *ten lessons* in the High School Course—or any Course of specialized training in the Coupon below—before deciding whether you wish to continue. If you are not then satisfied you are not out one cent. *We absolutely guarantee satisfaction.* On that basis you owe it to yourself to make this test. Check and mail the coupon NOW for full particulars and Free Bulletin.

AMERICAN SCHOOL OF CORRESPONDENCE
Dept. H-1202 Chicago, Illinois

TRAINING—THE KEY TO SUCCESS

Please explain how I can qualify for the position marked X

....High School Graduate	....Lawyer
....Electrical Engineer	....Business Manager
....Elec. Light & Power Supt.	....Certified Pub. Accountant
....Hydroelectric Engineer	....Accountant and Auditor
....Telephone Engineer	....Bookkeeper
....Telegraph Engineer	....Stenographer
....Wireless Operator	....Fire Insurance Expert
....Architect	....Sanitary Engineer
....Building Contractor	....Master Plumber
....Civil Engineer	....Heating and Vent. Engineer
....Structural Engineer	....Automobile Engineer
....Mechanical Engineer	....Automobile Repairman
....Shop Superintendent	....Airplane Mechanic
....Steam Engineer	....General Education Course
....Draftsman and Designer	....Common School Branches

Name .....

Address .....

Drilling a Well by Automobile

By P. P. Avery

WITH the help of an old motor-truck, a very serviceable well-drilling rig can be made. The power plant of the truck is sufficient for operating the drum and hoist for the drilling tools. A 2-ton truck will carry the attachment and drive the machinery.

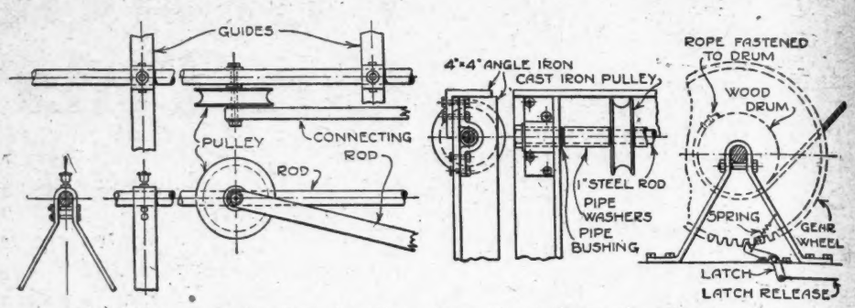
The body of the truck is not needed, and therefore is removed, leaving the bare chassis with the driver's seat and cab.

At the rear end of the truck-frame are placed two uprights made of 5-in. angle-iron. These are in two sections each, so that they may be taken down for transportation. The power transmission of the drill is constructed as shown. The left rear wheel is used for a power pulley. With the aid of a 5-ton screw-jack, this rear wheel is hoisted from the ground. Then some of the earth is scooped out, so that when the axle is again lowered the wheel does not touch the ground and can be turned by the power from the engine.

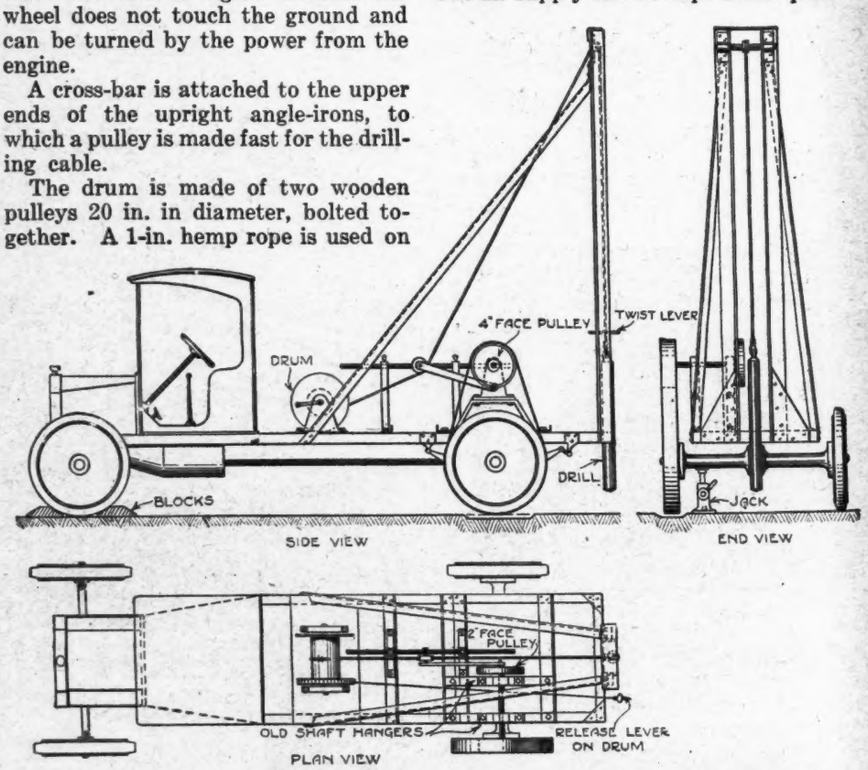
A cross-bar is attached to the upper ends of the upright angle-irons, to which a pulley is made fast for the drilling cable.

The drum is made of two wooden pulleys 20 in. in diameter, bolted together. A 1-in. hemp rope is used on the drum and over the pulley to the drilling tool. The drum is rotated on an axle 1½ in. in diameter, and this axle is supported by bar-iron brackets to the floor of the truck-frame. The cable is let out from the drum in the usual way, and the up-and-down movement driven by the eccentric action of the counter-shaft placed directly over the rear axle of the truck. This action is controlled by a pull lever from a position convenient to the man operating the drill. A handle 12 in. long is clamped to the cable at a convenient place for twisting it as the drilling proceeds. Thumb-nuts should be used on this clamping device, so that the handle can be changed as often as is necessary when the drill sinks into the earth.

The usual procedure is followed out in the drilling, and to tell when water is reached compressed air may be used. The air supply can be kept under pres-

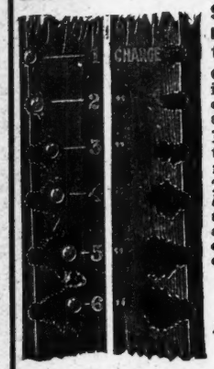


The sliding rope pulley that gives the reciprocating action to the drill rope, and details of the drum used to let out the rope as the drill enters the earth



An old motor-truck chassis is utilized for mounting the well-drilling attachment, and the truck's power plant is used to drive the well-drilling machinery

BENJAMIN



Speaking of air rifles, why not buy the best and safest?

Only real pump gun ever invented. Unlike all others, it never loses shooting force.

Man and boy's gun for target practice and small game hunting.

This perforated inch block of wood shows the various degrees of shooting force. This is a feat no other air rifle can duplicate.

Price $3.75

Postpaid in U. S.

Descriptive folder on request.

Ask your dealer for demonstration.

BENJAMIN AIR RIFLE & MFG. CO.
607 N. Broadway, ST. LOUIS, MO.

SEND for these BUNGALOW BOOKS

Plan Future Homes Now with Economy Plans of California Homes
—noted for comfort, beauty and adaptability to any climate.

"Representative Cal. Homes"
53 Plans, $2500 to $7000—60cts

"West Coast Bungalows"
72 Plans, $1200 to $2500—60cts

"Little Bungalows"
40 Plans, $500 to $2000—40cts

SPECIAL $1.50 OFFER
Send $1.50 for all 3 books and get book of 75 special plans. also Garage plans ..... **FREE**
Money back if not satisfied

E. W. STILLWELL & CO., Architects
735 Henne Building, Los Angeles

Build and Fly Model War Aeroplanes!

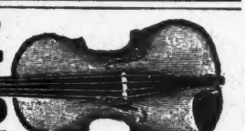
Build a Model Aeroplane that will fly like a real one. With IDEAL Scale Drawings and Building and Flying Instructions you can easily build exact 3ft. duplicates of War-famous Aeroplanes. Send now for Drawings and Instructions for the one you want to build.

Curtiss Military Tractor, Bleriot Monoplane, Nieuport Monoplane, Taube Monoplane, Curtiss Flying Boat, Wright Biplane, Cecil Peoli Racer. **25c each**

Catalogue of IDEAL Model Aeroplanes and Supplies, 5c. None Free.

IDEAL AEROPLANE & SUPPLY CO., 80-86 West Broadway, N. Y.

FREE



$20

Violin, Hawaiian Guitar Ukulele, Guitar, Mandolin, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we'll give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiian Guitar, Cornet or Banjo absolutely free. Very small charge for lessons only expense. We guarantee success or no charge. Complete outfit free. Write at once—no obligation.

SLINGERLAND SCHOOL OF MUSIC, Dept. 402, CHICAGO, ILL.

FREE. LAMP OR LANTERN

Akron Gas Lamps and Lanterns make best, cheapest light. Use gasoline. Simple, dependable, durable. Permitted by Insurance Companies.

GIVES 400-CANDLE POWER

Abundance of bright, clear, soft, steady light—restful to eyes. Fully guaranteed. AGENTS WANTED. All or spare time. Outfit free. Exclusive territory. Write for prices and FREE catalog. Sold at wholesale in open territory.

AKRON GAS LAMP CO., 482 GAS BLDG., AKRON, OHIO

NO CARBON—MORE POWER—LESS FUEL

OIL SEALING PISTON RINGS

NO-LEAK-O

Gives results no other ring can. Every set guaranteed. 7 years success. Popular sizes 50c. If your jobber can't supply you order direct. Parcel Post is quick. Write for free booklet S. **NO-LEAK-O PISTON RING CO., Baltimore, Md.**

Mathematics Made Easy

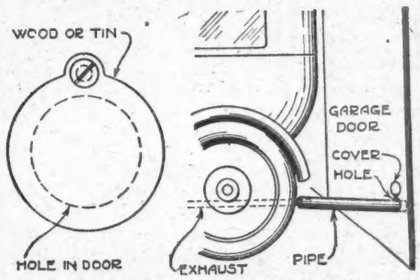
The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, Etc. Only 85c postpaid. Order today before you forget.

Dept. U, **L. J. LEISHMAN CO.** Ogden, Utah.

sure with an old motorcycle engine. The engine is used as a pump instead of an engine. To do this the inlet valve is held closed, and the air suction valve is screwed into the spark-plug opening. This improvised air-compressor is run by a grooved pulley on the countershaft of the well-driller and a round belt. A range boiler is used for storing the air under pressure. The air forced into the drilled hole will cause the water—if any is found—to shoot out at the top of the pipe.

How to Avoid Danger of Asphyxiation in a Garage

A SIMPLE way to fix a garage so that the motor may be run for any length of time without danger of



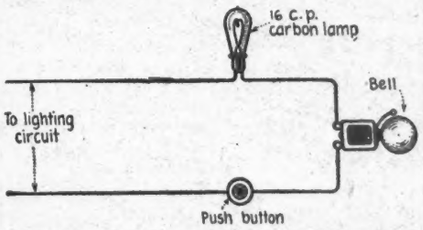
A pipe extension for the exhaust of an automobile to run the gases outdoors

asphyxiation to any one inside may be accomplished as follows:

Cut a hole about 2½ in. in diameter in the door. Over this fit a swinging door, to be closed when not in use. Take a 2-in. pipe, and place one end over the exhaust-pipe of the automobile and the other end through the small hole in the door.—S. L. FARWELL.

Door-Bell May Be Attached to a Lighting Circuit

DRY cells on a door-bell circuit can be eliminated by using the lighting circuit. Simply connect the wires to the lighting circuit, running one line directly to the bell through the push-button contacts and the other line through a carbon filament incandescent lamp, thence to the bell. The function of the lamp is to reduce the current in the circuit, so that the magnet coils in the bell will not burn out.



An electric light placed in a bell circuit, so that it can be used on a lighting main

Besides effecting a saving in the cost of batteries, there will be a minimum of trouble with the door-bell with this system. The lamp can be placed where it will show in another room from that in which the bell is placed, if it is so desired.—PETER J. M. CLUTE.

Pencils and eye glasses

You wouldn't read all day through another person's glasses. Then why work with a pencil not intended for your kind of work?

DIXON'S ELDORADO

"the master drawing pencil"

includes, among its 17 degrees, a pencil to suit each kind of work—each individual taste. The strong, smooth, responsive leads make work easier, quicker, more economical. 17 degrees—9H (hardest) to 6B (softest); HB (medium) for general work.

Write us the nature of your pencil work and your dealer's name, enclosing 15c in stamps, and we will send you full-length samples of the right degrees for you, worth double the money—also our chart showing the uses of the 17 degrees.

JOSEPH DIXON CRUCIBLE CO.
Dept. 120-J. Jersey City, N. J.

Canadian distributors **Established 1827**

A. R. MacDougall & Co., Ltd., Toronto, Ont.

In Winter weather carry a handy packet of

BROWN'S BRONCHIAL TROCHES

These lozenges give surprisingly quick relief from sore throat, coughing, hoarseness, tickling in the throat, loss of voice and kindred troubles.

Not a confection, but a safe, dependable remedy, put up in little packets that can be slipped into a vanity bag or vest pocket.

No Need to Fear Throat and Bronchial Troubles

Four sizes, 15c, 35c, 75c & $1.25. At all druggists.

John I. Brown & Son, Boston, Mass.

Agents for Continent of America:
Harold F. Ritchie & Co., Inc.
New York—Toronto

Safe Handy Dependable

TESLA

the World's Greatest Inventor

Contributes monthly signed articles, beginning in the February issue of

ELECTRICAL EXPERIMENTER
SCIENCE AND INVENTION

Now on sale at all newsstands

These articles will appear every issue for two years or more. They will be entitled, "'My inventions,' by Nikola Tesla." Each will explain one of this genius' marvelous inventions. You won't want to miss a single article so go to the nearest newsstand and secure youf February copy.

175 illustrations—80 big pages
Over 100 other articles
20c a Copy - - $2.00 a Year

3 sample numbers sent on receipt of 35c

The Electrical Experimenter, 235 Fulton St., New York

Fullest Pleasure from Your Boating

Convert your row-boat or canoe into a power-boat! Send for this book. It tells you how. And it bristles with valuable engine information, too.

MARINE LA ENGINES
Inboard & Outboard — 2 & 4 Cycle—2 to 20 H.P.

Portable, easily-attachable, LA outboard engines afford the joys of motor boating at little cost. A generous *30 Days' Trial* lets you try out LA Engines at our expense.

LOCKWOOD-ASH MOTOR CO.
1951 Horton Ave. Jackson Mich. (29)

Here's the New Auto-Wheel Book-Free

Write for Your Copy Today

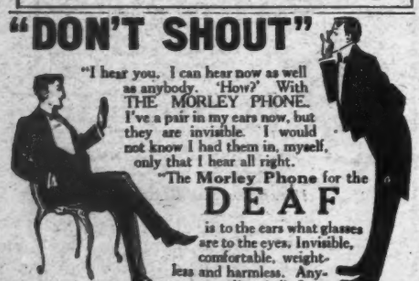
IT'S a book brimful of information a boy ought to have. It tells you how to organize an Auto-Wheel Coaster Club—how to make money with your Auto-Wheel—how to have the most fun when camping and what to do in case of accident. It's a valuable book—and it's yours for the asking.

Get A Free Felt Pennant

We want to tell you all about the wonderful Auto-Wheel Coaster and the patented Auto-Wheel Convertible Roadster and to send you one of our beautiful Felt Pennants FREE. When you write for the Auto-Wheel Book, give us the names of 3 coaster wagon dealers, mentioning which one handles the Auto-Wheel, and we'll send you a complete Auto-Wheel catalog and the Pennant—Free. Write us a letter today.

BUFFALO SLED COMPANY
157 Schenck St N. Tonawanda, N.Y. (In Canada: Preston, Ont.)

"DON'T SHOUT"



"I hear you. I can hear now as well as anybody. 'How?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right.

"The Morley Phone for the **DEAF** is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it." Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, Perry Bldg., Phila.

CONVERT YOUR BICYCLE INTO A MOTOR-CYCLE. Fits any Wheel.

PRACTICAL SUCCESSFUL and RELIABLE

Cost less and has many advantages over a heavy motor-cycle. Lowest prices

STEFFEY MFG. CO., Dept. S, 5625 Brown Street, Philadelphia, Pa.

Range-Finding in the Army

How to use range-finders to get results: the erect and inverted types

By George M. Petersen

THE ability to estimate distances, or find the range correctly, is a very important part of a soldier's education. Fire on the battlefield is usually by groups of men, and the range is given by the officers; but the battlefield is reached only after a great deal of scouting, patroling, and outpost duty, in which the soldier must depend upon his own powers of estimating distances in order to make his fire effective.

Fig. 1. Image of an invert range-finder

There are several ways of estimating distances. There are sound, trial shots, field-glasses, range-finding instruments, etc.; but the only one a soldier can depend upon is his eye and occasional trial shots. To estimate the range with the eye, it is necessary to be familiar with the appearance of a given unit of length, say 100 yards, and this is obtained by practising with different distances and then measuring them. The estimate may also be checked by noticing the appearance of the uniform, its clearness, the movements of the men, and other little features that will help him to solve this problem. Field silhouettes are also good practice, since they represent—to a certain extent, at least—conditions under which estimating will have to be done when actually in battle.

Some Obstacles to Range-Finding

Trial shots and ranging volleys are practicable when the earth is dry enough for the bullet to kick up some dirt when it strikes, the usual practice being to fire the first shot or volley at an estimated range, and then to increase or decrease the elevation of the piece until the bullets are falling in the desired place. There are many conditions that will bother even expert estimators.

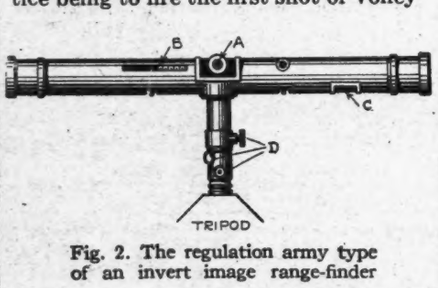


Fig. 2. The regulation army type of an invert image range-finder

Objects will appear to be nearer when they are in a bright light; when the color of the object contrasts with the color of the background; when the soldier looks over water, snow, or a uniform surface, such as a field of wheat or oats; when looking from a height downward; when in the clear atmosphere of high altitudes.

Objects will appear at greater distances when looking over a depression in the ground; when there is a poor light or a fog; when only a small part of the object can be seen; when looking from low ground upward toward higher ground.

It will be seen, therefore, that it is really difficult for any one man to get the range with even a fair degree of accuracy, unless the conditions are just right. It is therefore customary, when any number of men are shooting together, for the officer in charge to pick out from four to six men and have each one estimate the range of the target, the average of the estimates being taken as the correct range, until some line may be obtained on the actual distance. This method is fair enough; but the use of instruments, when they are obtainable, is much more reliable.

Mechanical Finders

Mechanical range-finders are known as erect-image and invert-image types of coincidence range-finders. The erect image type is generally used for naval and coast defense purposes where the objects have well defined outlines such as smokestacks, flag-staffs, and the like, which permit of precise alignment of the image.

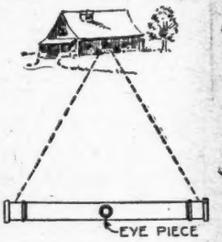


Fig. 3. Theory of obtaining results with the finder

The invert-image range-finders differ from the erect-image finders in that the image appearing in the upper half of the field is an inverted image of the lower half, but is not reversed right or left. The view through the eyepiece of this type of range-finder, when properly adjusted, is shown in Fig. 1. The instrument must be held steady, since a slight elevation will cause the image to separate vertically from the halving line, making it difficult to effect a coincidence.

The army type of invert-image range-finder is shown in Fig. 2, in which *A* is the eye-piece, *B* the scale showing the exact number of yards to the object sighted, *C* the halving adjustment, and *D* the leveling screws. These instruments are very complicated in their construction, and must be frequently checked against a known distance or corrected with the aid of

an adjusting lathe which is part of the equipment of each machine. Each instrument is also provided with a two shade ray filter, smoked for observing the rays of a search-light, and amber to moderate exceptionally bright daylight, either one being brought into use by turning a small lever on the eye-piece housing.

The range-finder, by means of a series of prisms, merely determines

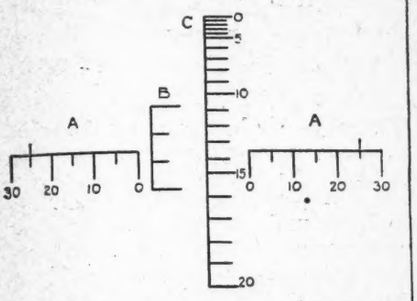


Fig. 4. The mil scales are used to determine the range and the corrector scale to correct it

the triangle; and the longer the base of the instrument the more accurate the measurements. The theory of the method of obtaining results with this instrument is shown in Fig. 3. When properly adjusted the image in the eye piece would be, in this case, as shown in Fig. 1.

Scale on Army Glasses

The quickest and most common way of determining ranges, except by using the average of several guesses, is by means of the range estimating and corrector scales engraved on the left lens of army field-glasses. These scales are shown in Fig. 4. The scales marked *A-A* in the drawing are known as the mil scales; *B* as the vertical mil scale; and *C* as the range corrector scale. The mil scales are used to determine the range, and the corrector scale to correct it.

To determine the range by the use of the scale, one must first estimate the width or height of the object sighted and then figure the range by the formula: *Range equals width or height x 1000 mils.*

For example: In Fig. 5 let it be considered that the building sighted is 30 ft. wide. This is estimated more or less accurately by the number and width of the windows, doors, etc. By holding the horizontal mil scale upon the object, we find that the building cuts off 25 mils, so that our range becomes

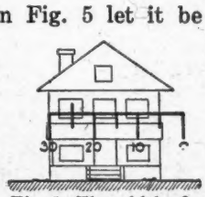
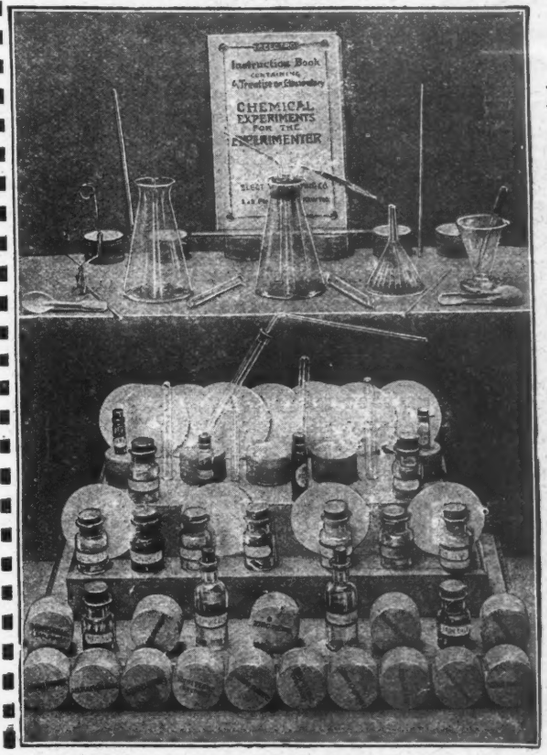


Fig. 5. The width of a building used as a base

$$\frac{30 \times 1000}{25} = 1200$$

In Fig. 6 we are using the average height of the telephone-poles in a certain vicinity which is about 20 ft. By focusing the vertical scale (mil) on

CHEMISTRY!?



DO YOU KNOW?

Do you know how to make chemical tricks?
Do you know how cloth is bleached?
Do you know how to test soil?
Do you want to make invisible ink?
Do you know how to test our
Do you know how Chlorine Smoke and Chlorine Gas (German War Gas), is made?
What do you know about chemistry in general?
These and hundred other interesting questions are answered and demonstrated with our **Chemistry Laboratory** which we present herewith.

We present herewith to our friends our new **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform **real** chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set with all the chemicals apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

The chemicals furnished are all technically pure and put up in appropriate wooden boxes and glass bottles, and there is a sufficient quantity to make dozens of experiments with each. The apparata are of standard laboratory size and quality.

Although all chemicals have nearly doubled in price we have decided not to raise the price for this outfit for the present.

Read the list of chemicals and apparata and look at the actual photograph of the outfit at your left.

And order one today!

44 Chemicals 18 Apparata
1 Instruction Book with 100 Experiments

PRICE, $5.00

Shipping Weight, 10 Lbs.
Can Be Shipped by Express Only

$5 E. I. Co. Chemical Laboratory

Description of the Outfit—It contains the following 44 chemicals:

Ammonium Chloride, Alum, Antimony, Boracic Acid, Charcoal, Sodium Nitrate, Sodium Carbonate, Sodium Borate, Sodium Sulphite, Manganese Dioxide, Oxalic Acid, Brimstone, Iron Oxide, Sulphate of Zinc, Magnesia Carbonate, Zinc, Metallic, Sodium Bicarbonate, Sodium Sulphate, Sodium Chloride, Calcium Sulphate, Barium Chloride, Lead Acetate, Ferrous Sulphate, Nickel Sulphate, Sodium Phosphate, Zinc Carbonate, Ammonium Sulphate, Ammonium Carbonate, Ammonium Aqua, Calcium Chloride, Chloride of Zinc, Copper Sulphate, Glycerol, Iron Chloride, Calcium Oxide, Stannous Chloride, Nickel Chloride, Hydrochloric Acid, Sulphuric Acid, Iodine, Mercury, Metallic, Tin, Metallic, Litmus Paper, Ferrous Sulphide

THE FOLLOWING APPARATA ARE FURNISHED:

One Standard Washbottle, One Conical Glass Measure, One Erlenmeyer Flask, One Glass Funnel, One Delivery Tube, Six Assorted Test-Tubes, One Test-Tube Holder, Ten Sheets of Filter Paper, One Glass Dropper, One Spoon Measure, Glass Tubing, One Spirit Lamp.

One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

IMMEDIATE SHIPMENTS

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 19 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 228 Big Pages, 600 illustrations, 500 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy."** 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 19 measures 7x9¼". Weight, ¾ lb. Beautiful stiff covers. **Cyclopedia sent only on receipt of 6 cents stamps to cover postage.**

ELECTRO IMPORTING CO., 229 Fulton Street, New York

Don't Wear a Truss

MR. C. E. BROOKS

Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.

Brooks' Rupture Appliance

Has automatic Air Cushions. Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.

C. E. BROOKS, 255A State St., Marshall, Mich.

Here's Health,

and Power, Vim and Vigor

Do you want them? Strength that is more than mere muscular strength. The strength, health, power and vigor of youth is now within your reach through the White Cross Electric Vibrator. Be strong—be healthy—enjoy things the way you used to. Write and learn what vibration will do for you.

The White Cross Electric Vibrator

With this machine in your home you can give yourself the same treatments for which specialists receive $3 to $5. Can be connected up as easily as an electric lamp. Or if your home is not wired for electricity, it will run perfectly on its own batteries. See it—try it.

Write Today For Our Big FREE BOOK

Just your name and address on a letter or post card is enough. We will send you absolutely free and prepaid, our new book, **"Health and Beauty."** It tells you all about vibration and about our special offer. Write today.

LINDSTROM-SMITH CO., Dept. 1909, 1100 S. Wabash Ave., Chicago

Red Seal Dry Batteries Are Guaranteed

to give absolute satisfaction for Automobiles, Motor Boats, Gas or Gasoline Engine Ignition, Medical Batteries, Telephone, Door Bells, Annunciators, Wireless Apparatus or any other open circuit work.

ASK YOUR DEALER

Send for Our New Edition of Our Catalog A28

It will be pocket size, 8x4½ and will contain 248 pages with over 1,100 illustrations, describing in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Telegraph Material, Electric Toys, Burglar and Fire Alarm Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

MANHATTAN ELECTRICAL SUPPLY COMPANY, Inc.

NEW YORK, 17 Park Place CHICAGO, 114 So. Wells St. ST. LOUIS, 1106 Pine St. SAN FRANCISCO, 604 Mission St.

PATENTS

IF YOU HAVE an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All patents secured by us are described in

SCIENTIFIC AMERICAN

without cost to patentee

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regards to *Patents, Trade Marks, Foreign Patents, etc.*

Munn & Co.

SOLICITORS OF PATENTS

683 WOOLWORTH BLDG., NEW YORK

and

627 F STREET, WASHINGTON, D. C.

the pole, we find that it is just 20 mils high; therefore our range is

$$\frac{20 \times 1000}{20} = 1000$$

It is a comparatively easy matter to judge the width of buildings and other objects of like nature, if attention is paid to the style of building used in a certain locality, the width of doors, windows, and average height from the ground to the cornice, etc.

Fig. 6. The average height of a telephone pole is used as a measurement

The use of the range corrector scale is shown in Figs. 7 and 8. In Fig. 7 the enemy is in a clump of bushes 1000 yards distant from us. We can see them with our glasses, but the men on the firing line cannot see them with the naked eye. In order to make their fire effective we must give them an auxiliary aiming point, and we accomplish this by placing the 1000 mark, 10 on the scale, on the enemy position, and find that the line of hills in the background cuts the scale at 500 yards. Therefore the men set their sights at 500 yards instead of the 1000 yards, and aim at the ridge of the hills instead of the clump of bushes in which the enemy is hiding. The result is that the bullets drop into the enemy position, and with just as good an effect as if they were fired from a point where the target could be clearly seen.

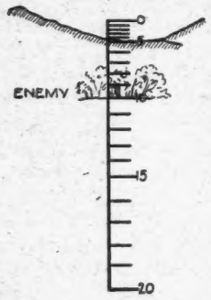


Fig. 7. A clump of bushes and a hillside used on the range scale

In Fig. 8 we have a concealed trench 1100 yards distant from us; but, because of its concealment, it cannot be picked out with the naked eye. We therefore place the 1100 mark of the corrector scale on the enemy position, and look for a well defined auxiliary aiming point. There is no distinct point in the rear of the trench, but there is a fence in the foreground which all of the men can see clearly. This fence cuts the scale at 1400 yards, so that the men lift their sights to 1400 yards elevation and aim at the top of the fence, the bullets dropping into the trench 1100 yards away.

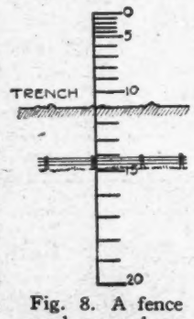


Fig. 8. A fence and enemy location determines the sight-setting

Although the field-glass method of estimating ranges is not so accurate as is the range-finder method, because of the fact that the width or height of the object must be determined beforehand, it is nevertheless a fairly accurate and a very handy method to use in an attack where ranges must be quickly determined. In long-range firing it is not necessary to aim at a particular individual every time a shot is fired, since by keeping the bullets dropping thickly around an enemy position they will become more or less demoralized and will not return a heavy fire.

How to Conquer the Stubbornest Jar Top

IT frequently happens that the screw cap on a jar or bottle becomes stuck so that it is almost impossible to unscrew it. A simple method that will bring the most stubborn cap to instant subjection is shown in the illustration. Cut a piece of sandpaper into a long, narrow strip about twice the width of

A leverage applied to a screw-top cover to remove it when set tightly

the cap to be removed, and fold it so that there will be a sand surface on both sides. Place this around the cap, and then wind a piece of stout cord—not string—around the sandpaper, crossing the second round over the first to prevent slipping. Two or three turns of the cord will be sufficient. Now tie a loop in the end, slip a poker or a piece of broomstick through it, and apply pressure. The tightest cap must come off, provided you use cord that is heavy enough to stand the strain.—ALBERT E. JONES.

How to Use Old Inner Tubes of Automobiles

IN these times when the price of tubes has so materially increased the cost of running an automobile, it behooves us to see that they give the greatest possible service. Do not throw away old tubes. Cut them up and use them in every way your ingenuity may suggest.

Washers, silencers for chair legs, rubber mats, and insulation for electrical instruments may be made from them. Small pieces of tubing placed under glass table-tops will prevent scratching of the table and make it easier to move the glass. A long strip may be cut from an old tube and used to prevent the rattling of an automobile wind-shield, a frequent source of annoyance, while similar strips can be used advantageously for weather-stripping on windows and doors.

These are only a few of the possible uses to which old tubes may be put.

10 Cents a Day Pays
for This Symphonola

Plays all records, Victor, Columbia, Edison, Pathe, Little Wonder, Emerson. Take a year to pay, after 30 days' trial. Compare its tone for clearness, volume with more costly instruments. Return at our expense if it fails to make good. Ask today for the **Beautifully Illustrated Symphonola Book FREE.** Shows this and other Symphonola styles sold on easy payments.
SYMPHONOLA RECORDS—Get our list of the latest song, dance, popular, clear sounding, full toned disc records. Playable on any Phonograph.

Larkin Co. Desk SPSM-219 Buffalo, N. Y.

Send Your Name and We'll Send You a Lachnite

DON'T send a penny. Just send your name and say, "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will send it prepaid right to your home. When it comes merely deposit $4.75 with the postman and then wear the ring for 10 full days. If you, or if any of your friends can tell it from a diamond, send it back. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.

Harold Lachman Co., 12 N. Michigan Av., Dept. 1202, Chicago

SMOOTH-ON HOUSEHOLD CEMENT STOPS LEAKS

Easy to apply as putty—lasting as iron. Repairs leaks, cracks, and breaks at little cost. Get a Can of SMOOTH-ON IRON CEMENT NO. 1 for every Household and Auto repair. Stops Auto Radiator leaks. 25c. and 50c. at Hardware stores. Write for interesting Booklet showing dozens of uses.

1 lb. 50c
6 oz. 25c

SMOOTH-ON MFG. CO.
Jersey City, N. J., U. S. A.

REPAIRS CRACKS

AGENTS 500% PROFIT

Gold and Silver Sign Letters

For store fronts, office windows and glass signs of all kinds. No experience necessary. Anyone can put them on and make money right from the start.

$30.00 to $100.00 a Week!

You can sell to nearby trade or travel all over the country. There is a big demand for window lettering in every town. Send for Free Samples and full particulars.

Liberal Offer to General Agents.

METALLIC LETTER CO., 400 N Clark St., Chicago

ELECTRICITY MADE SIMPLE

A book devoid of technicalities. Simple, plain and understandable. $1.00 Postpaid.

Popular Science Monthly, 225 W. 39th St., New York

Print Your Own
cards, circulars, labels, tags, menus book, paper. Press $6. Larger $20. Job Press $35 up. CUTS EXPENSES IN HALF. SMALL OUTLAY. Pays for itself in short time. Will last for years. Easy to use, printed rules sent. Print for others, BIG PROFIT. Write factory TODAY for press catalog, TYPE, cards, paper.

THE PRESS CO D-33, Meriden, Conn

YOU CAN'T LOSE PEN or PENCIL

Get this UP-TO-DATE combination clasp and yearly calendar. Prevents loss of pen or pencil. Saves Time. Best thing out. At all good stationers or from us—15c.

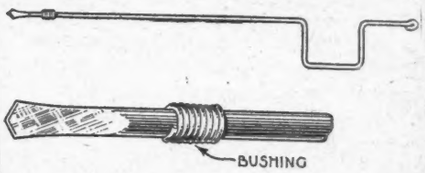
State for Pen or Pencil

Send stamps or coin

ARGUS MFG. CO., Dept A.
402-406 N. Paulina St., CHICAGO, ILL.

When a Bullet Sticks in Your Rifle

DID you ever get a bullet stuck in your rifle when not near a gunsmith or a shop? Here is a simple method for removing a lead bullet from a small-calibre rifle with the aid of a wire and a file. For a twenty-two rifle use a piece of No. 9 or 12 gage wire bent to the shape of a carpenter's brace, as shown in the



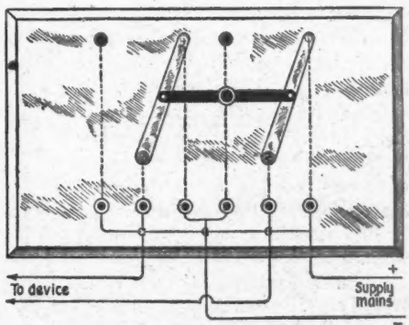
A drill-point made on the end of a rod for use in boring out a bullet in the barrel

sketch. Flatten the long end for about 2 in., and file this to the shape of a flat drill. To harden it sufficiently to hold an edge, stick this end in the fire until the wire is a dull red, and then thrust it in water. A bushing should now be made from a piece of fine wire or a strip of tin cut from a can, and placed on the wire near the drill-point. This bushing holds the drill in the center of the barrel and p events it from injuring the rifling.

Remove the bullet by drilling through it, and then with a ramrod push out the shell of lead that remains. If possible, run mercury through the barrel to dissolve any remaining lead. After this cleaning out the gun will shoot as well as ever.—C. M. VAIDEN.

A Simple Switch for Reversing Polarity of Wires

THE device here shown is a convenient means of changing the polarity of a pair of wires, or of reversing small motors. It consists of a wood base upon which are mounted



Moving the switch horizontally changes the polarity of the wires leaving the binding posts

six binding posts and a pair of two-point switches, so connected by a hard rubber strip that it will move both of the switches at the same time. The manner of reversing the polarity at once becomes evident by referring to the diagram. Connections from the binding posts are made in grooves on the under side of the wood base.—PETER J. M. CLUTE.

Put PEP Into Yourself!

STRONGFORT
The Perfect Man

This is an age of vim and vigor—of ginger and jump—of fighting men—of big things in the world and big men who put them through. *Don't lag behind.* Don't be content to drag yourself through your routine work each day without any get-up-and-go about you; without any ambition to better yourself or make things easier for your wife and happier for your children.

Fit Yourself to Be a Man Among Men

Are you handicapped by ill health? Is your digestion out of order or constipation poisoning your blood and brain? Is your vitality sapped by dissipation and your nervous system worn to a frazzle? *Get rid of these handicaps.* You can't amount to anything while you stagger under them; you can't be a success in your business, a comfort to your wife, a pleasure to your children—you can't beget healthy, happy children when you are a weak, anemic, irritable apology for a man yourself.

Make Yourself Over

You can do it; you can get back your lost health, happiness, vigor and vitality, *if you go the right way about it*; You can "come back," whatever your age and whatever brought you to your present condition; you can FIT YOURSELF to be a success in life, no matter how many failures are behind you; fit yourself to look any man in the face, to cope with him, and WIN OUT.

I'll Help You Do It

I'll help you, as I already have helped and am now helping thousands of other discouraged, ailing, formerly hopeless men. I'll show you how to improve yourself 100 per cent in a few weeks time; how to strengthen your heart, lungs and stomach; how to enrich your blood; how to develop your muscles, brighten your brain and forget you have any nerves.

My way is Nature's way—the Strongfort way—no patent medicines to stimulate you, and fool you into thinking you are better; no iron-bound rigid routine of muscle tiring exercises; just *living life*, as Nature meant it should be lived, and getting the greatest possible enjoyment out of it.

Send for My Free Book

Send for a copy of **"Promotion and Conservation of Health, Strength and Mental Energy,"** and send for it today, accompanied by three 2c stamps to cover postage and packing and I will forward your copy by return mail. It's free, and it tells you all about Strongfortism—the simple, safe way back to health and strength and manly vigor; the way that has been proved the *sure* way, both by myself and by my pupils in every part of the world.

LIONEL STRONGFORT
Physical and Health Specialist
765 Park Bldg. NEWARK, N. J.

.....CUT OUT AND MAIL THIS COUPON.....

Mr. Lionel Strongfort, Newark, N. J.
Dear Strongfort:—Please send me your book **"PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY,"** for postage of which I enclose 6 cents in stamps to cover mailing expenses. I have marked (X) before the subject in which I am interested. (765)

..Colds	..Deformity	..Nervousness
..Catarrh	..Insomnia	..Poor Memory
..Asthma	..Heartweakness	..Rheumatism
..Obesity	..Short Wind	..Poor Circulation
..Headache	..Flat Feet	..Skin Disorders
..Thinness	..Constipation	..Despondency
..Rupture	..Biliousness	..Round Shoulders
..Neuritis	..Torpid Liver	..Lung Troubles
..Neuralgia	..Indigestion	..Increased Height
..Flat Chest	..Bad Habits	..Weaknesses

NAME .....

STREET .....

CITY ..... STATE .....

AGE ..... OCCUPATION .....

How to Make a Water-Heater for the Poultry-Yard

A VERY successful design for a poultry water-heater is shown in the illustration. The heater is made of two principal parts, the lamp-holder and the tank. As designed, it is the correct size to use in winter, when the stock is full grown. By

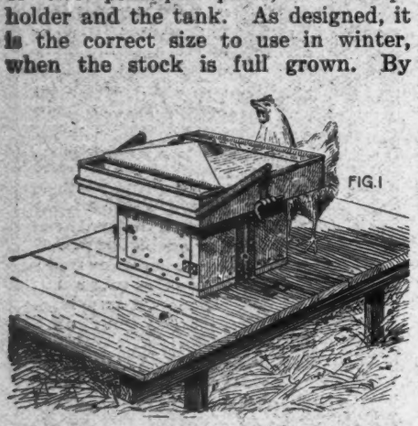


FIG. 1

The heater as it is used in the poultry house to keep the drinking water warm

proper regulation of the lamp flame the temperature of the water can be kept tepid, thereby preventing it from freezing when the mercury drops below 32° F. This will permit the fowl to get a drink early on cold mornings. The assembled view of the water-heater, with all its parts in place, is shown in Fig. 1.

The heater section is shown in detail in Fig. 2. The general dimensions will give an adequate idea of its size. The detail *A* shows the method of building the bottom up around the side. The tin is formed around a heavy wire on top, and soldered. This will make the heater compartment very rigid. The door is shown in detail *B*. It is made of two pieces riveted together, the piece *a* lapping over ½ in. at the top, bottom, and on the lock side, and about ¼ in. on the hinge side. The piece

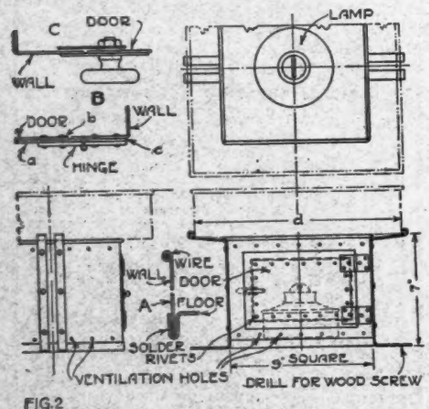


FIG. 2

Details of the lamp compartment, which is made of metal and bound with wire at the edges to keep it very rigid

b should be 1/16 in. smaller all around than the door opening. Two hinges can be riveted to the door as shown, with a piece of tin *c* placed under the opening. The lock is shown in detail at *C*. The handle should be fastened parallel to the bar, because when placed in this position it will always indicate whether the lock is open or closed. The bracket for holding the tank in place is shown at *d*. There should be two of these brackets on each side. They are made of ⅝ by 3/32 in. strap-iron formed as shown. A lower extension is provided so that a hole may be drilled through it and the heater compartment fastened to a platform, thus eliminating the possibility of its tipping over and causing a fire. Two or three rivets can be used to fasten the brackets to the sides. The distance *d* should be exactly the same as the width of the tank.

The water-tank is made up of three compartments. The central, which holds the main supply of water, is covered, and the end ones, from which the fowl drink, remain exposed. The rim should be formed over a heavy wire in the same way as the top rim of the heater compartment was made. This

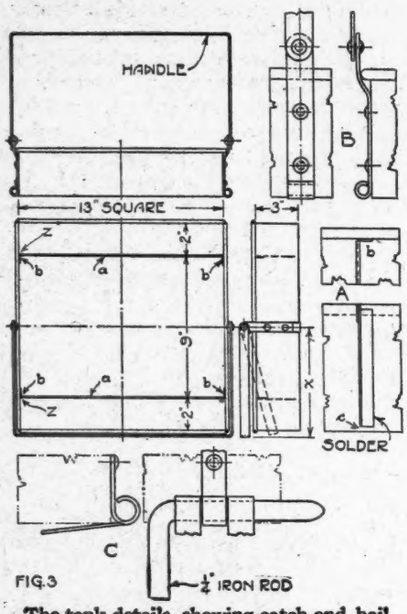


FIG. 3

The tank details, showing catch and bail handle to be used when lifting the heater

will make the tank rigid, and will give a pleasing finish, the rounded surface preventing the fowl from injuring themselves. The dividing walls *a* can be constructed as shown in detail *A*, soldered as at *b*, with a space left as shown at *c*. This space is to permit the water to flow from the main to the drinking compartments.

The dividing walls not only act as supports for the cover, but also provide additional bracing for the tank. The handle and tank locking brackets can be made as shown in detail *B*, the brackets being made of the same material as are those used on the heater compartment, that is, ⅝ by 3/32 in. strap-iron. The handle can be of the same material, and loosely riveted so that it will swing freely. The distance *x* on the handle should be great enough so that when the handle is swinging down out of the way it will rest in the position shown by the dotted line. The main water compartment is shown in Fig. 4.

The purpose of the two sets of brackets is to provide a locking device, so that the tank cannot be accidently tipped off from the heater compartment. The method of locking the two compartments together is shown

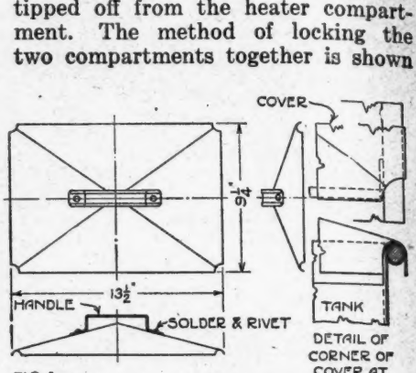


FIG. 4

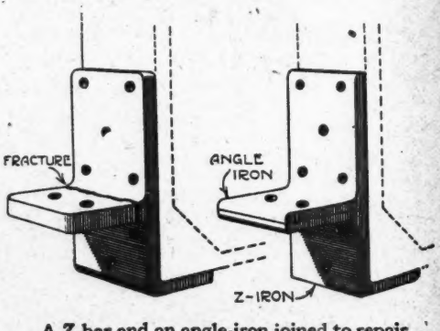
Detail of the cover, which is not as wide as the tank, thus allowing drinking space

in detail *C* of Fig. 3. The bolts can easily be slipped out when the poultryman desires to remove the tank for cleaning and filling, and can be very quickly slipped back into its proper place.

The heater may be an ordinary small tin brooder lamp which will require very little care—just that of cleaning the wick and filling the lamp once or twice each week, depending entirely on the size of the lamp reservoir.—FRANK W. HARTH.

How to Repair a Broken Bracket on an Automobile Radiator

ONE of the brackets supporting the radiator of my automobile broke at the point indicated in the illustration, and, realizing the length of time



A Z-bar and an angle-iron joined to repair the broken bracket of the radiator support

it would require to replace it with a new one, I decided to repair the bracket at home.

From a neighboring structural iron shop I procured an odd piece of angle-iron and an old piece of Z-bar. These I cut to the proper width and height to match the other bracket, after which I drilled holes for rivets, using the broken bracket as a jig. They were then swaged and riveted to the radiator, and the job when complete and painted was so perfect that it would have been difficult to tell which was the repaired one.—ADOLPH KLEIN.

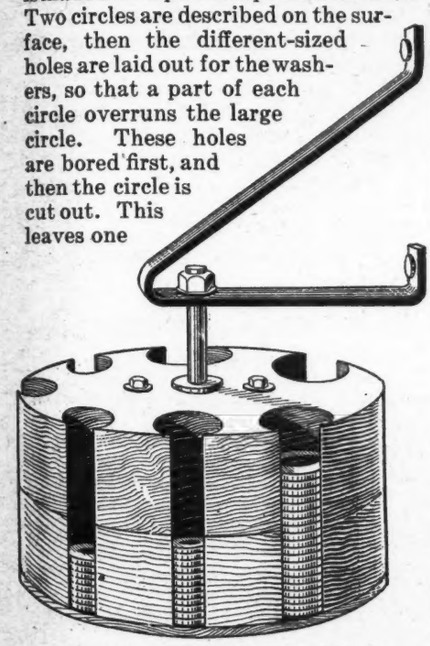
When in Need of a Compass Use Your Watch

IT is not generally known that a watch will make a good compass in the woods if the sun is visible. Hold the watch face up, and point the hour-hand toward the sun. True south will then be half way between the hour-hand and the XII point on the dial.

The explanation is simple. The sun swings through an arc of 180° from east to west, while the hour-hand turns 360° on the dial from 6 A. M. to 6 P. M. Thus the hand travels twice as fast as the sun, and they meet, or coincide, at XII noon, when both are at the meridian.—E. EARL GLASS.

A Convenient Way of Keeping Washers of Different Sizes

A CONVENIENT holder for washers of different sizes is patterned after the familiar poker-chip holder. It is made of two pieces of plank 2 in. thick. Two circles are described on the surface, then the different-sized holes are laid out for the washers, so that a part of each circle overruns the large circle. These holes are bored first, and then the circle is cut out. This leaves one side of each hole open. Make a baseboard and bracket from which to hang it on the wall, and the holder is complete. Being suspended at the center by a single bolt, it can be revolved, making it easy to select the washer wanted.—C. H. WILLEY.



The poker-chip holder furnished the idea for making this washer holder

A Non-Corrosive Anti-Freezing Solution for Automobiles

A SOLUTION for water-jackets on gasoline engines that will not freeze at any temperature above 20° F. may be made by combining 100 parts of water with 75 parts of carbonate of potash and 50 parts of glycerine by weight.

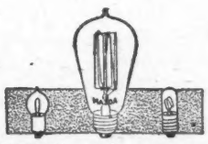
This solution is non-corrosive and will remain perfectly liquid above its congealing point.—HERMAN NEUHAUS.

MAZDA

"Not the name of a thing, but the mark of a service"

MAZDA is the trademark of a world-wide service to certain lamp manufacturers. Its purpose is to collect and select scientific and practical information concerning progress and developments in the art of incandescent lamp manufacturing and to distribute this information to the companies entitled to receive this service.

MAZDA Service is centered in the Research Laboratories of the General Electric Company at Schenectady, N.Y. The mark MAZDA can appear only on lamps which meet the standards of MAZDA service. It is thus an assurance of quality. This trademark is the property of the General Electric Company.



A MAZDA Lamp for every purpose

4H44

RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY

This Trade-Mark Is Your Insurance of Quality

E. C. SIMMONS KEEN KUTTER CUTLERY TOOLS

The quality of articles bearing this trade-mark never varies. Regardless of changes in design and finish that may prove desirable at times, the quality of materials and workmanship always remains the highest.

SIMMONS HARDWARE COMPANY

"The recollection of QUALITY remains long after the PRICE is forgotten."
—E. C. SIMMONS.

Trade Mark Registered

A Good, All-Around Tool Bag

Made of Harness Leather—Strong and Durable

Combines all the good features of the various common leather bags. Strongly built for rough usage. Bottom is three ply and steel studded. Has saw and bit holder, hand strap, and shoulder strap with pad. A mighty good, all-around tool bag. Six sizes ranging from 14 x 8 inches to 24 x 8 inches. Show this ad to your dealer and ask for the genuine KLEIN tool bag. If unable to get it write us.

MATHIAS KLEIN & SONS, Mfrs.
CANAL STA. 3, CHICAGO

WHITING-ADAMS BRUSHES
USED BY THE
U. S. ARMY AND NAVY
Used By
RAILROAD AND STEAMSHIP COMPANIES
Used by Manufacturers of
CARS, AUTOMOBILES, CARRIAGES

There are actually several million persons in the United States who are continually using Whiting-Adams Brushes.

Send for Illustrated Literature
JOHN L. WHITING-J. J. ADAMS CO.
Boston, U. S. A.
Brush Manufacturers for Over 108 Years and the Largest in the World

BIG PROFITS for YOU in HB BATTERY CHARGING

Battery charging is a wonderfully profitable business that you can handle without any special electrical or mechanical experience. With no better opportunity than yours, many HB owners are clearing

$100 to $150 Extra Profit Every Month

Some even more. This HB 500-watt Charger recharges 1 to 7 auto storage batteries at once with current cost of only 12c to 15c per battery. Automatic pays 75c to $1.50. Anyone can operate. Requires little attention and no extra help. Big profits quickly and easily made.

$15 Puts This Money-Maker in Your Garage

Balance in 9 monthly payments of $20 each. Earnings should easily more than meet all payments. Write for full particulars or send $15 first payment with trial order. Delay means lost profits. Order charger at once from this ad. No risk. Absolute money-back guarantee. Do it today.

HOBART BROTHERS COMPANY
Box 52. Troy, Ohio

Pilliod
TOOL CASES EXCEL

Machinists and Tool Makers find them most satisfactory from every standpoint—construction, appearance, service and price.

Booklet describing 19 styles on request.

The Pilliod Lumber Co.
Swanton, Ohio

Cranking a Ford Automobile in Cold Weather

CRANKING Ford engines on a cold morning is sometimes difficult as most Ford owners know. One of the reasons for this is that the oil flowing in between the clutch-plates is stiffened by the cold, and tends to prevent the crank-shaft from turning. To overcome this, drop the emergency brake-lever forward when putting the car up for the night, and pull it back just before cranking the engine.

Dropping the lever forward brings the clutch-plates together, forcing the oil out from between the plates or disk surfaces; so that when the clutch is again released, just before starting the engine, there is no friction caused by the oil.—FRANK J. L. HAVERLAND, JR.

Anchoring the Rocking-Chairs in a Hotel Lobby

WHERE rocking-chairs are provided in public places, it is always a great annoyance to those in charge to have them moved about. In one large hotel the problem of anchoring the rocking-chairs has been solved satisfactorily.

Six chairs are placed in a row on each side of a long fireplace, and a ½-in. rope is stretched tightly just above the curved rockers and fastened securely at each end to a strong ring attached to the floor. This permits adjoining chairs to be shifted over a surprisingly wide horizontal space without interfering with the vertical rocking motion, at the same time prohibiting the chairs from being moved to points in the room where they would be in the way.—JOHN D. ADAMS.

Treating Polished Surfaces So They Will Photograph without Halo

EVERY photographer who has taken a picture of an automobile or other object having a good deal of nickel plate about it knows that if the subject is in the sunlight there is always glaring reflection from the nickel work, resulting in an ugly halation on the exposed plate. Many an otherwise perfect negative has been practically ruined in this way.

The handle-bar of the motorcycle showing the halo was not touched, while the other was given a few strokes of yellow chalk

Seeking a means of eliminating this trouble, I conducted numerous experiments without success. Finally I tried marking transverse stripes with yellow chalk on the offending nickel parts, and have found this to do the work perfectly. The yellow chalk, which may be readily wiped off after the picture is taken, breaks up the reflection of sunlight just enough to prevent the halation, without making an impression on the negative of sufficient strength to print out in the finished picture. The discovery has been worth a great deal to me, and no doubt will also be sure to help other photographers.—JOHN EDWIN HOGG.

A long rope run through the rockers and fastened at both ends keeps the chairs in place; yet they may be moved slightly when two occupants wish to face each other

Build Your Own Grandfather's Clock

with our help

We furnish blue prints, finishing material and instructions. Buy the works, dial, weights and pendulum from us at surprisingly low prices. You make a fine profit building artistic clocks for your friends.

Complete Works $5.00
Others with chimes at all prices

Ask for attractive Free Offer

CLOCK COMPANY
1623 Ruffner St.
Philadelphia, Pa.

Genuine Armstrong Stocks and Dies

Have You a Set in Your Kit?

Some of the advantages of Genuine ARMSTRONG Stocks and Dies:
They can be adjusted to the variations in the size of fittings.
Results are accomplished with less work and time.
The Dies are interchangeable in the stocks and they can be sharpened without drawing the temper.
Our catalog tells the rest of this interesting story; send for it *to-day*.

THE ARMSTRONG MFG. CO.
337 Knowlton Street - Bridgeport, Conn.

THE ANDERSON STEAM VULCANIZER

Anderson's Flexible Conformation Device, upon which an ordinary monkey wrench exerts tons of pressure, forces thousands of little rubber rivets into the tire's fabric, to be cooked in by our superheated dry steam system.

We guarantee to make practical vulcanizers out of men 20 to 70 years old. $235 and 5 to 10 days in one of our many State Vulcanizing Schools will start you in this profitable business.

The Anderson Steam Vulcanizer Co., No. 3 Williams Bldg. Indianapolis, Ind.
Manufacturers of the Famous Anderson Steam Vulcanizer. Owners of the Anderson method of vulcanizing.

TOOL CHESTS

If it is chests, we can supply you. That's our business.

Write for Circulars

J. M. WATERSTON
81 Woodward Ave., Detroit, Mich.

THE MIDGET SLIDE RULE

will add, subtract, multiply, divide; solve problems involving even and uneven roots and powers. Also gives the logarithms of numbers and the Sines and Cosines, Tangents and Cotangents of all angles. Its operation is very simple: quickly solves any mathematical problem. Durably made of metal. Adapted for shop and office use. Fits the pocket, 3½ inches in diameter.

Price with instructions, $1.00.
Your money back if you are not satisfied.
Gilson Slide Rule Co., Niles, Mich.

ARMATURE AND MAGNET WINDING

By Horstmann & Tousley
A necessary book for Electricians. Full facts and diagrams, $1.50 postpaid.
Popular Science Monthly, 225 W. 39th St., New York

LEARN TELEGRAPHY

at home in shortest possible time, Morse or Wireless. OMNIGRAPH AUTOMATIC TRANSMITTER, connected with Sounder or Buzzer, sends you messages at any speed, just as expert operator would. Adopted by U. S. Govt. 6 styles. Catalog free.

OMNIGRAPH MFG. CO.
39-H Cortlandt St., New York

Quality First

TOOL CASES

for

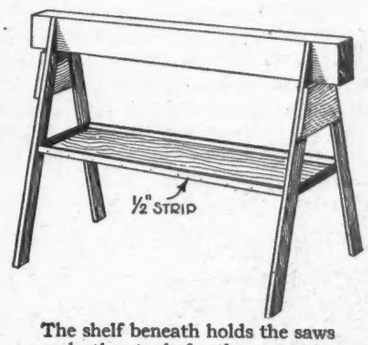
Machinists and Toolmakers

Write for our booklet showing the best built and most practical selection of Tool Cases on the market. We ship direct from factory and guarantee to please you or refund all money.

H. Gerstner & Sons.
50 Columbia St., Dayton, Ohio

A Sawhorse with a Shelf for Different Tools

A SHELF made of a wide board and placed midway between the top of a sawhorse and the floor provides a handy place for the saws and



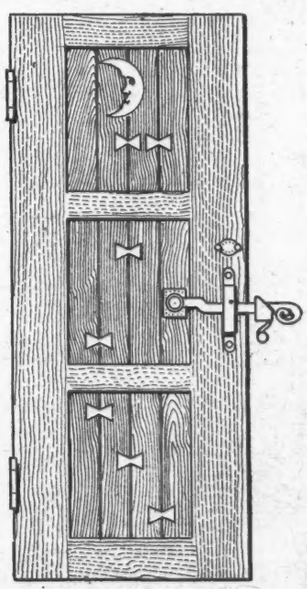
The shelf beneath holds the saws and other tools for the carpenter

other tools that a carpenter needs at hand when using the horse. The edge of the shelf should be provided with a small strip projecting above the upper surface to hold the tools.

The shelf does not add much weight to the sawhorse, and it keeps the tools out of the way when they are not in use.—DALE R. VAN HORN.

This Door Tells the Kind of Business Done Behind It

AS an advertisement a local lumber dealer in a small city built an office door of narrow beaded boards, making three panels as shown in the illustration. To relieve the blank appearance, the architect attached a carved half moon and a number of



An office door built of lumber-yard material to represent the business

smaller ornaments to break up the monotony of the joints.

The ornaments were cut out of hardwood ¼ in. thick. A hand-hammered lock and finger plate completed the scheme. The door, as well as the ornaments, were finished in natural wood.

Your Machines Must Compete

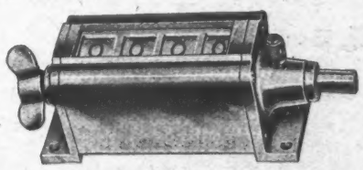
Every owner-operator of machines has to keep down his production-costs to meet competition; he's better able to do it with machines having Veeder Counters.

The output of your Veeder-equipped machine may be held to the highest point recorded by the counter—or brought still higher by such operating methods or mechanical developments as register gains on the *counter*.

The best rate-of-work you can *get* from machines is assured by

Veeder
COUNTERS

—and the lowest unit production-costs go hand in hand with that speed.

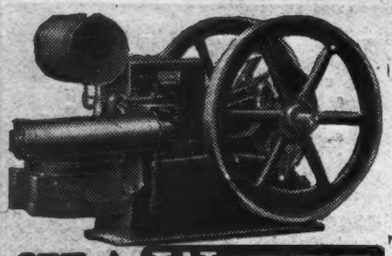


The Revolution Set-Back Counter above registers one for a revolution of a shaft, recording an operation of your machine. Set back to zero by turning knob, and supplied with from four to ten figure-wheels, as required. Price, with four figure-wheels, $8.50 (subject to discount).

The small Rotary Ratchet Counter below counts reciprocating movements of the lever, where these correspond with the operations of your machine. When lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. Suitable for a wide range of small machines, and a very durable counter. Price, $1.75.

The big industrial concern or the small inventor have equal need for VEEDERS. Both will find what they want in free booklet on Veeder Counters.

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.



GET A WITTE
"KERO-OIL" ENGINE

Have More Power—Do your work easier—Get a better engine—At less cost—Make more money—Save more fuel—Immediate Shipment Direct from Factory—No long waiting—Five-Year Guarantee Deal Direct—Hundreds of Engines—2 to 30 H-P.—all styles—Ready to Ship—Suit yourself as to terms—Cash—or Payments—or

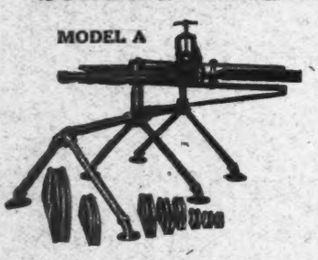
MONEY BACK if not satisfied On my New 90 Day Engine Offer

NO MONEY DOWN if arranged for. Write for my latest book, (copyrighted) "How to Judge Engines"—tells you all about engines and fuels, and why I can sell a better engine at wholesale factory price. I ship everywhere in the U.S.—guarantee safe delivery—save you $15 to $200. I can ship big engines—or small engines—on wire orders. Write me today—ED. H. WITTE, Pres.

WITTE ENGINE WORKS
2225 Oakland Ave., Kansas City, Mo.
2225 Empire Bldg., Pittsburgh, Pa.
Largest Exclusive Engine Manufacturer in the World Selling Direct to the User.

WONDER
10 MODELS
Pipe, Tubing and Solid Bar Benders

MODEL A



BEND all sizes of standard or double thick steel, wrought iron, brass and copper pipe from ⅛" to 6"; tubing from ½" to 7"; round, square and twisted solid stock from ¼" to 1¼" to 3".

American Pipe Bending Machine Co.
Manufacturers
51 Pearl St., BOSTON, MASS., U. S. A.

Arithmetic of Electricity—A practical treatise on electrical calculations of all kinds reduced to a series of rules. *$1.00 Postpaid.* Popular Science Monthly, 225 West 39th St., New York.

Sexual Knowledge
ILLUSTRATED
BY WINFIELD SCOTT HALL, M.D., Ph. D.
SEX FACTS MADE PLAIN

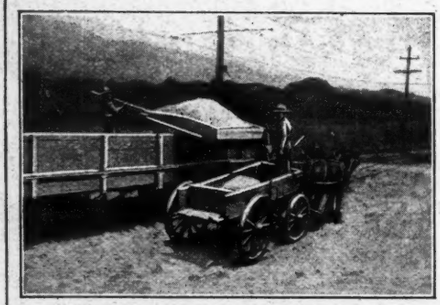
What every young man and woman—
Every young wife and husband—
Every father and mother—
Every teacher and nurse should know.
Complete in one volume
Cloth binding—320 pages—many illustrations
Table of contents and commendations, on request
$1 Postpaid Mailed in plain wrapper
AMERICAN PUBLISHING CO.
217 Winston Bldg. Philadelphia

For Taking Freight from Railway Cars

By E. Earl Glass

WHEN unloading stone or other bulk material from open cars, the cost of the work may be considerably reduced by shoveling the stone into a loading-box which dumps almost instantly when a wagon drives under it. These loading-boxes may be bought in stores, but it is less expensive to make them.

The box shown here has proved a success in handling road materials in southern California, permitting almost continuous shoveling at the car and uninterrupted travel for the teams. Since a wagon is held for only one minute in taking on a load, the output of the hauling outfit is greatly increased. When several teams are employed, the best results are obtained by using two boxes.

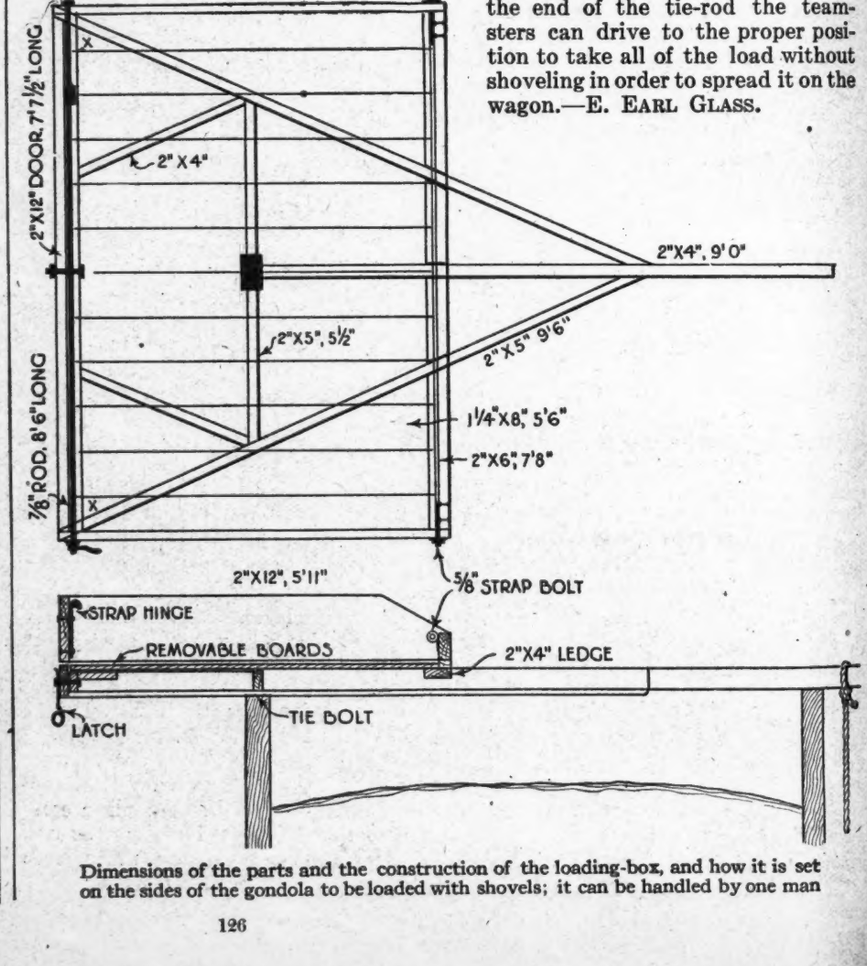


Dumping the load from the box on the gondola to the wagon-box at the side

Another advantage in the use of the loading-box is that the men in the car can see their work, and do not have to step to one side of the car to learn whether they are loading in the wagon or on the ground. In handling fine materials, such as sand and screenings, the men can use scoops. This greatly increases the efficiency of a loading crew.

The Y-frame, which is the heaviest part, is made of select fir. The other parts of are of soft wood, and they may be dismantled by removing the four nuts at the corners of the box. The side boards are fast to the floor slats upon which they rest, and these are prevented from spreading by the corner bolts and the small bearing lugs at X. The door is hung from the long tie-rod, by iron strap-hooks, and the box is balanced on the edge of the gondola car, as shown in the picture. Old tie-plates prevent it from slipping when in an elevated position.

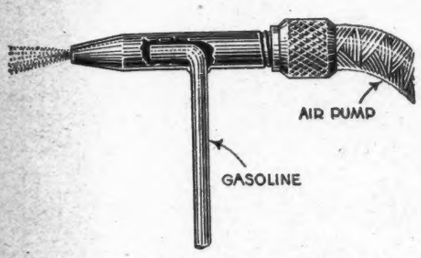
The pole is tied down while loading the box, and it is a wise precaution to keep the end of the pole tied to the truss-rods under the car by a rope of just sufficient length to limit the lift of the pole to the dumping position, thus preventing the box from overbalancing a careless workman. The box holds a generous wagon-load of two tons, or 1½ cubic yards, and by hanging a short plumb-line from the end of the tie-rod the teamsters can drive to the proper position to take all of the load without shoveling in order to spread it on the wagon.—E. Earl Glass.



Dimensions of the parts and the construction of the loading-box, and how it is set on the sides of the gondola to be loaded with shovels; it can be handled by one man

A Gasoline Sprayer for Cleaning Engine Parts

PROBABLY the quickest way to clean metal parts is to spray them with gasoline, or, preferably, because of the danger of fire, with kerosene.



A home-made sprayer for use in cleaning dust and grit from parts of a machine or engine

The apparatus for doing the spraying costs practically nothing, as the requisites consist of scraps of copper tubing, some rubber tubing, and a compressed-air supply. The outfit is shown in the accompanying sketch.

The rush of air causes a vacuum in the gasoline pipe, so that the gasoline or kerosene is drawn up and mixed with the air to form a fine spray. The mixture is discharged with sufficient force to dislodge any dirt adhering to the metal parts.

The air-pipe is 5/16-in. copper tubing and the gasoline or kerosene pipe is 3/16-in. The latter is bent at right angles and inserted in the former as shown. This device is very useful in cleaning the parts of an automobile engine.—ERNEST SCHWARTZ.

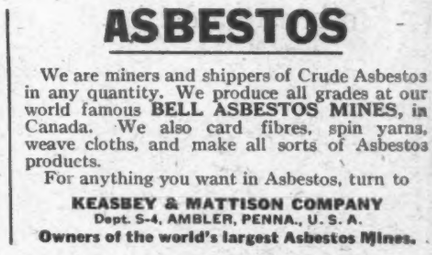
Brazing Broken Tools Without Injury to Temper

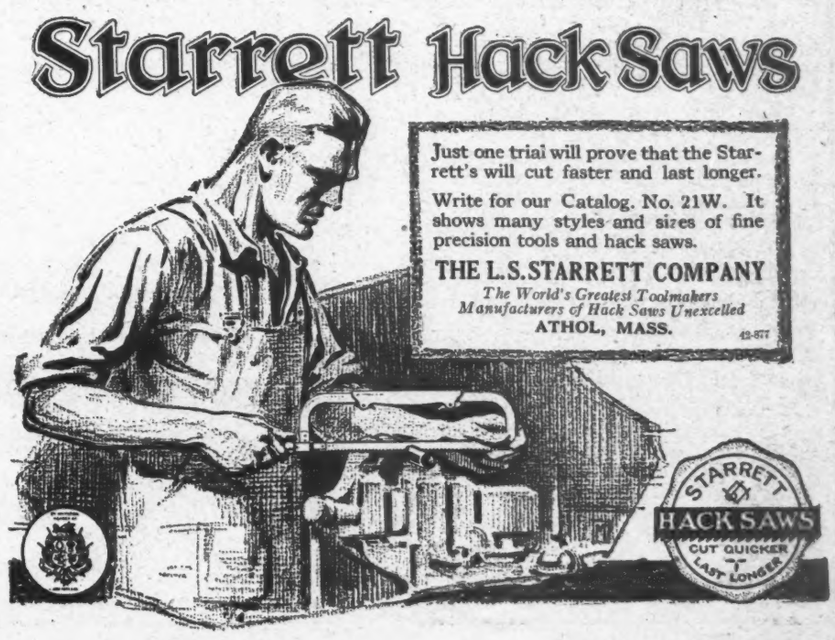
BROKEN shanks on tools may be joined with a brazed joint without injury to the tempered part by the following method: Take a good-sized potato, and stick it on the tempered part and close to the break. The joint should be prepared in some manner to hold the parts together while brazing them. A dovetail wedge or pieces riveted to the sides may be used. The dampness in the potato will keep the tempered part cool enough during the operation to prevent drawing the temper.

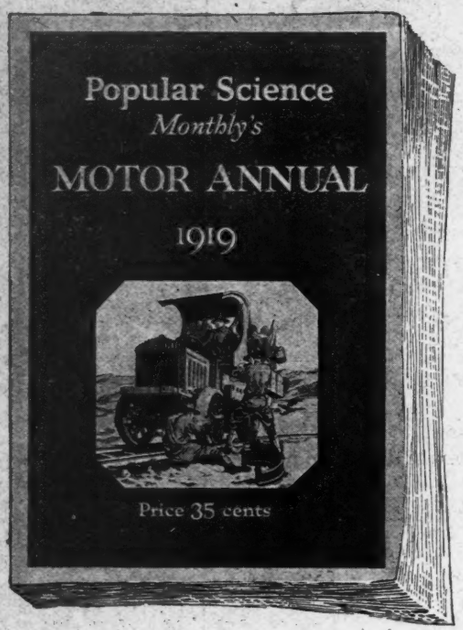
A potato keeps the edge cool and prevents the temper being drawn while brazing

Buy Them by Name
It does not matter for what particular job you require a certain tool, you can always find the one you need among the 1000 varieties of
BROWN & SHARPE
MACHINISTS' TOOLS
And it is well worth your while to see that the name Brown & Sharpe is back of every tool you buy. It is assurance that for accuracy and long, dependable service you have obtained the best procurable.
Catalog 27, describing the complete line, mailed on request.
Brown & Sharpe Mfg. Co.
PROVIDENCE, R. I., U. S. A.
B·S
TRADE MARK

1/4 H.P., 110 volts, A.C. 60 cycle, single phase, 1750 R.P.M.
MOTORS
We have 1000 NEW WASHING MACHINE MOTORS. These are of standard manufacture and carry the regular factory guarantee. Shipped in original boxes. Complete as cut.
Bought from Bankruptcy Stock
Suitable for operating Coffee Grinders, Cream Seperators, Bottle Washers, Air Compressors, Small Lathes, Etc
Mail $3.50 cash or Money Order. We will send C.O.D. subject to full examination
MONEY BACK GUARANTEE
$18.50 EACH
MANUFACTURERS DISTRIBUTER
GRAS. H. JOHNSTON - West End - Pittsburgh, Pa.


ASBESTOS
We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES, in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.
For anything you want in Asbestos, turn to
KEASBEY & MATTISON COMPANY
Dept. S-4, AMBLER, PENNA., U. S. A.
Owners of the world's largest Asbestos Mines.


Starrett Hack Saws
Just one trial will prove that the Starrett's will cut faster and last longer.
Write for our Catalog. No. 21W. It shows many styles and sizes of fine precision tools and hack saws.
THE L.S.STARRETT COMPANY
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.
42-877
STARRETT
HACK SAWS
CUT QUICKER
LAST LONGER



The Motor Annual of POPULAR SCIENCE MONTHLY *is absolutely invaluable to every one interested in motor vehicles. Over 400 pictures of new devices and accessories.*

400 New Ideas
for Motor Car and Truck Owners

This is your chance to get the greatest book ever published for owners and users of motor cars and motor trucks. It pictures and describes all the new accessories and all the new devices for saving fuel, tires and engines. It gives many practical new ideas for remodelling bodies, converting old chasses, making economical repairs.

Over four hundred new ideas are described and there are over four hundred photographs and other illustrations. The book is edited by the best known automobile authorities, and is reliable and practical. Tractors, trucks and trailers, business cars and pleasure cars, all are included in the rich contents of this volume.

THE 1919 MOTOR ANNUAL

will be published about February 20th. Only a limited edition will be printed and you should order your copy right away to make sure of getting it. Use the blank below. The price is very low for so big and valuable a book.

Here are a few of the automobile parts and accessories for which new inventions or new ideas are given in the Motor Annual:—Windshields, magnetos, chains, lamps, inner tubes, mud hooks, jacks, truck bumpers, safety locks, heating devices, clutches, brake bands, water pumps, tire pumps, gasoline pumps, mufflers, grease guns, spark plugs, radiator fans, shock absorbers, pistons, automatic door openers, cold weather devices. Dozens of articles give specific directions for getting increased efficiency from engines, head lights, oil, gasoline. Many ideas for economical home repairing are included.

CUT THE COUPON AND CUT YOUR MOTOR COSTS

Popular Science Monthly
225 W. 39th St., N. Y.

Please save me a copy of the 1919 Motor Annual of Popular Science Monthly. I enclose 35 cts.—Send, postpaid when issued, about February 20th.

Name _____

Address _____

Price—35 cents, postpaid